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PLATES IN VOL. V.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[TENTH SERIES.]

"................. per litora spargite muscum
Naiades, et circùm vitreos considite fontes:
Pollice virgineo teneros hic carpite flores:
Floribus et pictum, divæ, replete canistrum.
At vos, o Nymphæ Craterides, ite sub undas
Ite, recurvato variata corallia trunco
Vellite muscosis e rupibus, et mihi conchas
Ferte, Deæ pelagi, et pingui conchylia succo."
N. Parthenii Giannettasi, Ecl. 1.

No. 25. JANUARY 1930.

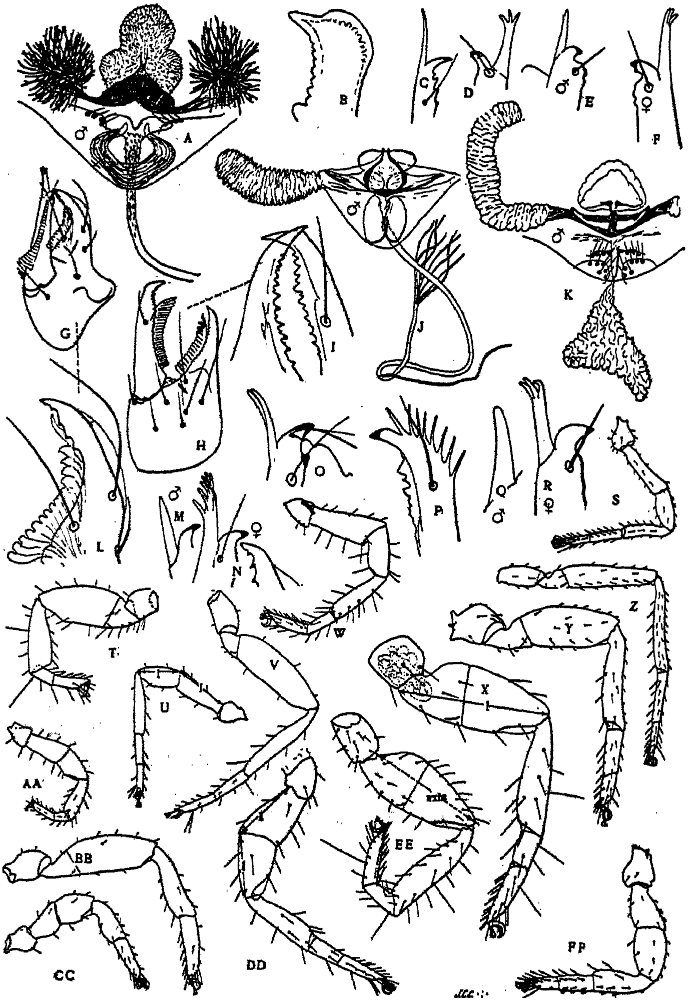
I.—*A Synoptic Classification of the False Scorpions or Chela-spinners, with a Report on a Cosmopolitan Collection of the same.*—Part II. *The Diplosphyronida* (*Arachnida-Chelonethida*). By JOSEPH CONRAD CHAMBERLIN, A.B., M.A., Stanford University, California, U.S.A.

1. INTRODUCTION.

As in the first paper of this series (Chamberlin, 1929), a number of figures (figs. 1–3) are herewith given in order to elucidate the terminology employed and to illustrate the more important systematic distinctions. They are not primarily designed to illustrate particular species; hence the form of the captions and the nature of the citations.

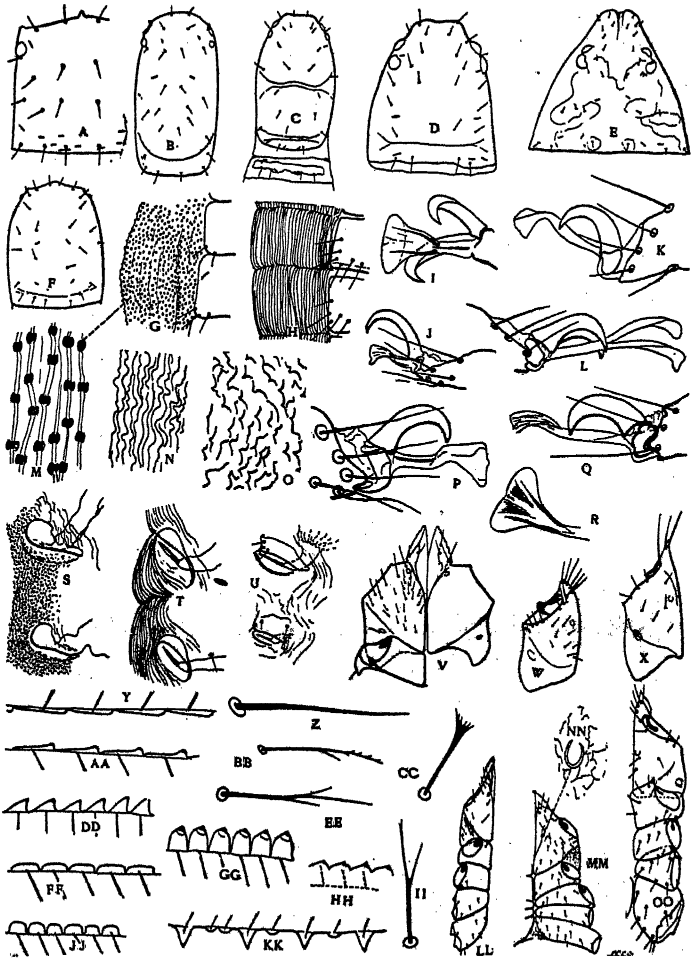
In the Diplosphyronids palpal proportions, within certain limits, are of primary importance, especially in discriminating between species. It is therefore of importance that measurements be taken in a standardized way from definite key-points. All palpal measurements must be taken as illustrated in fig. 3 X in order to yield results strictly comparable with those given in this paper. The term femur-patella which is occasionally employed in connection with

Fig. 1.



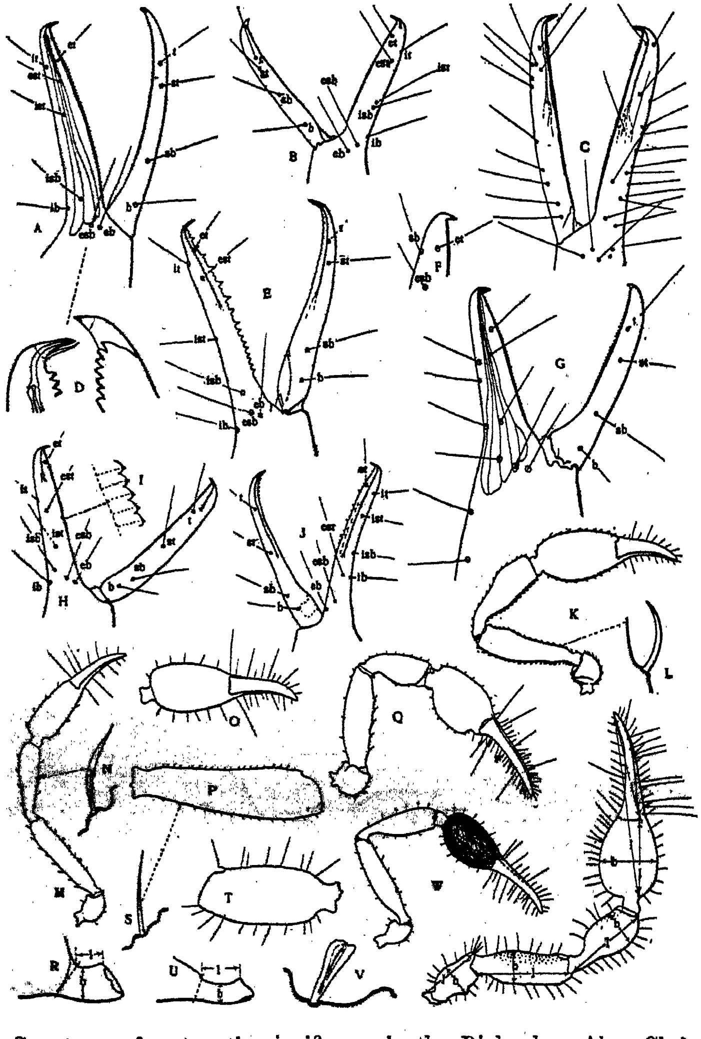
Structures of systematic significance in the Diplosphyronida. Characteristic types of male genitalia, A, J, K. Spinnerets, B, C, D, E, F, M, N, O, P, Q, R. Sexual differentation in galeate spinnerets, E, F; M, N; Q, R. Serridentate chelicera, H, I. Unilobate chelicera, G, L. Subapical lobe of unilobate chelicera, E, F, O, R. Morphological variation in leg iv., T, V, X, Y, Z, BB, EE. Morphological variation in leg i., S, U, W, AA, CC, DD, FF.

Fig. 2.



Structures of systematic significance in the Diplosphyronida. Carapacal types, A, B, C, D, E, F. Pleural membrane types, G, H. M, N, O. Empodia, I, J, K, L, P, Q, R. Spiracles, S, T, U. Maxillæ, V, W, X. Marginal teeth of chelæ (orientation, apex of fingers to left), Y, AA, DD, FF, GG, HH, JJ, KK. Subterminal setæ of tarsus, Z, BB, CC, EE, II. Coxæ, LL, MM, OO.

Fig. 3.



Structures of systematic significance in the Diplosphyronida. Chelæ showing dentition, chætotaxy, and venom-system, A, B, C, D, E, F, G, H, I, J. Various diplosphyronid palpi, K, M, Q, W, X. Palp showing mode of taking measurements, X. Tibial pedicels showing mode of taking length and breadth, R, U. Details of palpal structures, L, N, O, P, S, T, V.

leg iv. comprises both those segments taken as a unit, and is to be measured as indicated in fig. 1 X. The length so taken is not to be considered as taken along the longitudinal axis of the compound segment. This latter, as here understood, is indicated in fig. 1 EE. The relative lengths of femur and patella of leg i. are occasionally of systematic importance. Their lengths should be measured as indicated in figs. 1 U & DD. The slenderness of the pedicel of the tibial segment of the palpus is of importance in certain groups. Its length and breadth is to be taken as indicated in figs. 3 R & U.

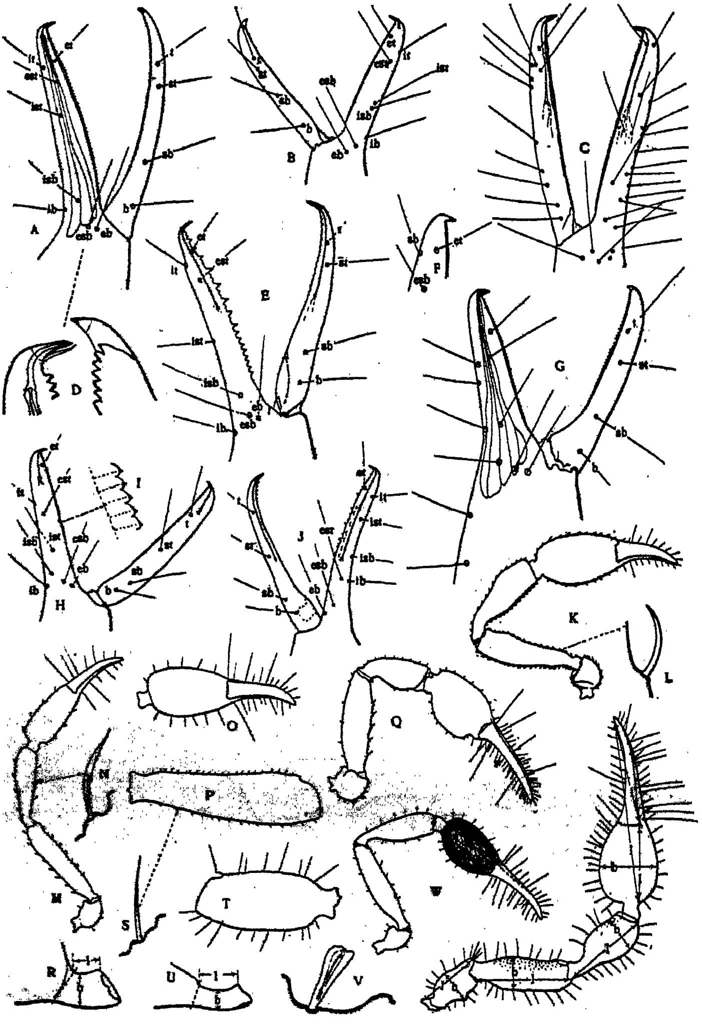
Ordinarily variation in proportions is small. At the same time it must be recognized that where material is scanty (as is all too frequently the case) it is not possible to say whether the particular proportions stated are typical (average) or extreme. Hence considerable allowance must be made for this factor in practical work, especially in the case of species known from but one or two specimens each. In this connection it is important to keep in mind the general fact that the female, in nearly every case, is significantly larger and stouter in its proportions than the male. In my experience I know of only a few cases where the length of a palpal segment, for instance, will vary in its extremes more than 0·5–0·8 its own breadth. Where more than one specimen is available for study the extremes of proportion actually observed are given, and these are not sexually differentiated unless the variation due to this factor is considerable, or unless there is a tendency toward "overlapping" on the part of it and a closely related form. Where a series of proportions are derived from a single specimen the actually observed proportions are given, and no range of variation is indicated except rarely in keys, where this may be estimated within reasonable limits on the basis of other criteria.

The descriptive term *subequal* as employed herein in comparing relative lengths of parts means merely that the two contrasted structures are essentially equal within very small limits of variation in either direction.

Total body-length as an index of size is frequently useful. This measurement is taken from the anterior carapacal margin to the tip of the abdomen, and is from specimens which have been treated in caustic potash and mounted in Canada balsam. Alcoholic material will ordinarily measure distinctly less, about in the ratio of 9 to 10 ordinarily.

The chætotaxy of the chela is of great systematic importance. Various typical arrangements of tactile setæ

Fig. 3.



Structures of systematic significance in the Diplosphyronida. Chelæ showing dentition, chætotaxy, and venom-system, A, B, C, D, E, F, G, H, I, J. Various diplosphyronid palpi, K, M, Q, W, X. Palp showing mode of taking measurements, X. Tibial pedicels showing mode of taking length and breadth, R, U. Details of palpal structures, L, N, O, P, S, T, V.

leg iv. comprises both those segments taken as a unit, and is to be measured as indicated in fig. 1 X. The length so taken is not to be considered as taken along the longitudinal axis of the compound segment. This latter, as here understood, is indicated in fig. 1 EE. The relative lengths of femur and patella of leg i. are occasionally of systematic importance. Their lengths should be measured as indicated in figs. 1 U & DD. The slenderness of the pedicel of the tibial segment of the palpus is of importance in certain groups. Its length and breadth is to be taken as indicated in figs. 3 R & U.

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The chætotaxy of the chela is of great systematic importance. Various typical arrangements of tactile setæ

clearly illustrating the terminology employed in their connection are illustrated in figs. 3 A, B, C, E, H, J, and G. The tactile setæ are referred to individually throughout this work by the abbreviations indicated in the figures, with the exception that in the text they are always cited in capitals, thus: ET, EST, IT, etc. Their position is often indicated in terms of finger-lengths or, rather, fractions thereof. In such cases a finger-length (whether referring to fixed or movable finger) is the length of the movable finger as seen from a lateral aspect and taken from its apical tooth to its proximal exterior angle. When close together the distance between tactile setæ may be stated in terms of areolar diameters. An areolar diameter is to be understood as the diameter of the areole of one of the tactile setæ of the chela. It is a useful and reliable unit of measurement.

The nature of the venom-apparatus is of primary systematic importance, and must be ascertained with care. This can easily be done from a chela which has been dissected off, opened up, carefully cleared, and mounted on its side in Canada balsam. All the gross structures of the venom-apparatus may then be seen through the translucent chitin. Two of the possible three variants in the distribution of the venom-apparatus are found in this suborder—*i. e.*, it may be present in both fixed and movable finger (figs. 3 C, E, H, & J); or it may occur only in the fixed finger (figs. 3 A, B, D, & G).

In some groups the carapacal chætotaxy is stated as a formula (*e. g.*, 4–6 (24)). Interpreted, this particular formula indicates that the anterior margin is bordered by 4, the posterior margin by 6, while the carapace as a whole bears a total of 24 setæ.

2. Systematic Section.

Section **HOMOSPHYRONIDA**, J. C. Chamberlin.

1929. J. C. Chamberlin, p. 78 *.

Suborder Diplosphyronida, J. C. Chamberlin.

1929. J. C. Chamberlin, p. 78.

Type. The family Garypidæ, Hansen.

Remarks. Cosmopolitan in distribution. Includes seven families and two superfamilies, which are characterized in the following key:—

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* These references are to the "Bibliography," which will appear at the end of the paper.

Analytical Key to the Superfamilies and Families of the Diplosphyronida.

1. Both fore and hind legs comprising but a single tarsal segment (fig. 1 BB, CC) .. 8.
   Both fore and hind legs comprising two tarsal segments each (fig. 1 T, AA; U, V; W, EE) .... 2.
2. Movable finger of chelicera clearly multidenticulate, without a true subapical lobe (fig. 1 H, I, C, P); serrula interior truly serrulate throughout and not basally laminate (fig. 1 H); subterminal seta, with few exceptions, forked or otherwise toothed or modified (fig. 2 BB, CC, EE, II); carapace generally epistomally produced (fig. 2 A, F). (Superfamily NEOBISIOIDEA, nov.) .... 3.
   Movable finger of chelicera with a single (rarely secondarily subdivided (fig. 1 E, F)) subapical lobe or tooth, never multidenticulate (fig. 1 G, D, O, R); teeth of serrula interior basally fused (proximally at least) to form a membranous plate, apical teeth strongly differentiated and non-serrulate (fig. 1 L); subterminal setæ in all known cases completely simple and acute (fig. 2 Z); carapace often somewhat emarginate and rarely if ever epistomally produced (fig. 2 B, C, D, E). (Superfamily GARYPOIDEA, nov.) .... 6.
3. Venom-apparatus developed in fixed finger only, the tip of the movable finger with a definite sheath differentiated for the reception of the venedens (fig. 3 A, B, D). 4.
   Venom-apparatus developed in both fixed and movable fingers, a definite sheathing device only rarely being developed on either finger (fig. 3 C, E, H, J) .... 5.
4. Pleural membrane of abdomen smoothly longitudinally plicate, never granulate (fig. 2 H); femoral articulation of leg iv. at least slightly oblique to *longitudinal axis* (fig. 1 X), and generally strongly so (almost as in fig. 1 T) .... Family SYARINIDÆ, [nov., p. 38.
   Pleural membrane of abdomen granulate or granulo-striate (fig. 2 G, M); femoral articulation of leg iv. truly vertical to long axis of femur-patella (fig. 1 EE) .. Family NEOBISIIDÆ, [nom. nov., p. 9.
5. Pleural membrane of abdomen granulate (fig. 2 G); with the normal complement of 12 tactile setæ on fingers of chela (fig. 3 J); subterminal seta in only known case simple and acute (fig. 2 Z) .... Family HYIDÆ, nov., [p. 41.
   Pleural membrane of abdomen evenly longitudinally plicate (fig. 2 H); usually

(except in *Bochica*) with many tactile setæ on fingers of chela, far in excess of the normal 12 (fig. 3 C); subterminal seta in all known cases more or less dentate or forked (about as in figs. 2 BB, EE, II). Family IDEORONCIDÆ, [nov., p. 42

6. Venom-apparatus developed in fixed finger only, a well-marked sheathing device developed on opposing movable finger (fig. 3 G, D); fixed finger of chela with more than the normal complement of 8 tactile setæ (11–12) in all known cases (fig. 3 G); pleural membrane smoothly plicate; carapace extremely sclerotic and very elongate (fig. 2 B) .... Family MENTHIDÆ, [nov.

Venom-apparatus developed in both fixed and movable finger, no sheathing device developed on either finger (fig. 3 H, J); chela with the normal 12 tactile setæ at most (fig. 3 H, J); pleural membrane plicate or wrinkled; carapace variously modified, but not as above (fig. 2 C, D, E). 7.

7. Pleural membrane smoothly and evenly plicate (fig. 2 H); carapace only rarely significantly triangular (fig. 2 C, D); abdomen not subovate, but with more or less parallel sides, not greatly broader than cephalothorax; vestitural setæ of palpal femur and tibia prominent (or relatively so) and always slenderly acute (fig. 3 T); stigmatic helix small, but always clearly present (fig. 2 T) .... Family OLPIIDÆ, nov.

Pleural membrane granulo-hispid or wrinkled-plicate (fig. 2 S, O, N); carapace always significantly triangular (fig. 2 E); abdomen always subovate and much broader than cephalothorax; vestitural setæ of palpal femur and tibia markedly short and inconspicuous, the shortness being especially noticeable if the setæ are acute (fig. 3 P, S; also M, N, Q, K, L, V); stigmatic helix present or absent (fig. 2 S, U) .... Family GARYPIDÆ, [Hansen.

8. With four well-developed eyes .... 9.

With two or no eyes .... Family CHELIFERIDÆ, [Hansen (old sense) *.

9. Carapace typically garypoid (fig. 2 E); abdomen without pleural plates and carapace, with neither alæ nor horn-like protuberances anterior to the eyes; legs i. and iv. strongly differentiated morphologically (fig. 1 BB, CC) .... Genus *Synsphyronus*, [nov., of the family Garypidæ.

* Not treated herein. This "family," or, rather, complex of families, will include the bulk of the forms to be treated in Part III. of the present series of papers.

Carapace not garypoid, with at least two prominent horn-like protuberances anterior to the eyes; with either carapacal alæ or abdominal pleural plates; legs i. and iv. of essentially the same morphological structure	[Ellingsen *. Family FEÆLLIDÆ;

Superfamily *NEOBISIOIDEA*, nov.

Type. Family Neobisiidæ, nom. nov.

Diagnosis and Remarks. Characterized in preceding key. Cosmopolitan in distribution, but, so far as present knowledge is concerned, predominantly of the Northern Hemisphere.

Family **Neobisiidæ**, nom. nov.

1894. *Obisiidæ*, Hansen, p. 231.
1906. *Obisiidæ*, With, p. 74.

Type. The genus *Neobisium*, nom. nov.

Diagnosis and Remarks. Characterized in key to families. Cosmopolitan in distribution, but predominantly Holarctic. Includes two well-marked subfamilies, which are diagnosed in the following couplet:—

Key to the Subfamilies of the Neobisiidæ.

Spinneret present or absent; if present, never galeate, but represented at most by a strongly sclerotic knob (fig. 1 B, I)	NEOBISIINÆ, p. 9.
Spinneret always present as one or more transparent galeal processes (fig. 1 C, D, P)	IDEOBISIINÆ, p. 22.

Subfamily *NEOBISIINÆ*, **nom. nov.**

1879. *Obisiinæ*, Simon, vii. p. 50.
1894. *Obisiinæ*, Hansen, p. 232.
1906. *Obisiinæ*, With, p. 75.
1928. *Obisiinæ*, Kästner, p. 9.

Type. The genus *Neobisium*, nom. nov.

Diagnosis and Remarks. Characterized in key. The substitution of the name Neobisiinæ for Obisiinæ is elucidated under the generic heading. All members of this subfamily are apparently Holarctic in distribution. The included

* Not dealt with in this paper. See Chamberlin, 1923 (*a*).

genera and subgenera are characterized in the following analytical key :—

Key to the Genera and Subgenera of the Neobisiinæ.

1. SB and ISB absent (*i. e.*, 3 tactile setæ on movable and 7 on fixed fingers of chela); T and ST 3–5 areolar diameters apart; apical curve of maxilla with 3 border-setæ . *Microbisium*, p. 20.

   T and ISB present (*i. e.*, 4 tactile setæ on movable and 8 on fixed fingers of chela); ST and SB at least 6 or 7 areolar diameters apart, SB clearly closer to B than to ST; apical curve of maxilla with 4 or 5 border-setæ (fig. 2 W) .... 2.

2. ET, EST, and IT clearly situated on distal fourth, or more usually fifth, of fixed finger; legs and palp extraordinarily slender—fingers of palps four or more times as long as breadth of chela; blind European cave-dwelling species .... *Blothrus*, p. 11.

   ET, EST, and IT not all included on distal fourth or fifth of fixed finger (generally on distal third (fig. 3 A); legs and palpi not unusually slender—fingers of chela rarely (and then but little) more than twice as long as breadth of chela; non-cave forms generally with either two or four eyes (if eyes, as is rarely the case, are extremely reduced or possibly absent, separation is easily effected on the basis of preceding characters). (Genus *Neobisium*, nom. nov.) .... 3.

3. IST clearly on basal half of fixed finger of chela, forming together with EB, ESB, IB, and ISB a subbasal group of five tactile setæ; EST clearly submedian, and about as close to ISB as to ET; femur no longer than carapace (eyes four; in one species these are very weakly developed, and blind species may be expected) .... Subgenus *Parobisium*, [p. 17.

   IST at least submedian and generally anterior of median; an isolated basal cluster of five setæ never developed; femur of palpus always clearly longer than carapace (eyes two or four) .... 4.

4. With two eyes; IST and ISB more or less median between the two groups of ET, EST, IT, and EB, ESB, and IB respectively, so that these two clusters of setæ are more or less connected by IST and ISB as intermediates .... Subgenus *Roncus*, [p. 12.

   With four eyes; IST closely associated with EST, ET, and IT, while ISB is closely associated with the basal group of setæ, so that nearly half a finger-length of vacant space intervenes between these two groups of four tactile setæ each (fig. 3 A) ...... Subgenus *Neobisium*, [p. 13.

Genus Blothrus, Schiφdte.

1848. *Blothrus*, Schiφdte, p. 23.

Genotype. *Blothrus spelæus*, Schiφdte.

Remarks. As re-characterized this genus comprises a compact and apparently natural group of European cave-species. In addition to the two species specifically referred to below, the following forms almost certainly pertain to this genus as here defined :—*Obisium* (*Blothrus*) *jeannelli*, Ellingsen, from Spain; *Obisium* (*Blothrus*) *bolivari*, Nonidez, from Spain; *Obisium* (*Blothrus*) *cerberus*, Simon, from France; *Obisium* (*Blothrus*) *antrorum*, Simon, from France; *Obisium* (*Blothrus*) *torrei*, Simon, from Italy; *Obisium* (*Blothrus*) *peyerimhoffi*, Simon, from "Basses-Alpes"; *Obisium* (*Blothrus*) *breuili*, Bolivar & Pieltain, from Spain; and *Obisium* (*Blothrus*) *nonidezi*, Bolivar & Pieltain, from Spain.

"*Blothrus*" *magnus*, Ewing, and "*Blothrus*" *californicus*, Banks, do not in any wise pertain to this genus.

Blothrus spelæus, Schiφdte.

1848. *Blothrus spelæus*, Schiφdte, p. 23, figs.

Material examined. ♀, co-type (JC. 407.01001), loaned through the courtesy of Dr. Kai L. Henriksen. 1 ♀ (JC. 35.01001), Carniole Grotto, France; exchange from Dr. Louis Fage. The type-collection was from Adelsburg Cave.

Remarks. The French specimen, while pallid, was less so than Schiφdte's co-type.

Blothrus abeilli, Simon.

1872. *Blothrus abeilli*, Simon, p. 224, figs.

Material examined. 1 ♀ (JC. 34.01001), from the Grotto de St. Guilhern, Herault, France. Exchange from Dr. Louis Fage.

Remarks. A more robust and less pallid species than *spelæus*.

Genus Neobisium, nom. nov.

1817. *Obisium*, Leach (in part.), pp. 48–53.
1879. *Obisium*, Simon, p. 51.
1906. *Obisium*, With, p. 76.
1911. *Obisium*, Kew, p. 54.
1928. *Obisium*, Kästner, p. 10.

Genotype. *Obisium muscorum*, Leach. Designated by Simon.

Historical Identity. The genus *Obisium* was proposed by Illiger in 1798, with *Chelifer cancroides* (Linn.) as its only included species. As pointed out by Kew in 1911 (p. 54, footnote 2) this makes it a strict synonym of *Chelifer*, Geoffroy. The adoption of the name by Leach for use in connection with the species *muscorum* cannot be sustained. A new name therefore becomes necessary for the present group, which, in spite of the very evident synonymy, has gone under the name of *Obisium* ever since Leach's time. *Neobisium* is therefore proposed as a substitute. The change is regrettable, but impossible to avoid under the International Rules of Nomenclature.

Diagnosis and Remarks. Characterized in key. This is primarily a Palæarctic genus, reaching its greatest development in Europe. It has one or two eastern North American representatives. Most, if not all, of European false scorpions previously assigned to the genus *Obisium*, sensu stricto, belong here. This is probably not the case with *most* extra-European forms.

Subgenus Roncus, L. Koch.

1873. *Roncus*, L. Koch, p. 44.
1879. *Roncus*, E. Simon, p. 63.
1911. *Roncus*, Kew, p. 53.

Genotype. *Roncus lubricus*, L. Koch.

Diagnosis and Remarks. Characterized in preceding key. Two species were originally ascribed to the genus *Roncus* by Koch. One of these, *Roncus cambridgei*, is not a true *Neobisium*, but rather a member of the genus *Microcreagris*. The only species certainly referable to the subgenus are strictly European.

Neobisium (*Roncus*) *lubricus*, L. Koch.

1873. *Roncus lubricus*, L. Koch, p. 44.
1911. *Obisium* (*Roncus*) *lubricum*, L. Koch, Kew, p. 53.
1928. *Roncus lubricus*, L. Koch, Kästner, p. 10.

Material examined. 1 ♀ (JC. 27.01001), from Bona Algiers, exchange from M. Louis Fage. 1 ♀ (JC. 31.01001), from Genoa, Italy (Ellingsen's determination); exchange from British Museum.

Neobisium (*Roncus*) *abditus*, sp. n.
(Figs. 1 H, I, W, EE; figs. 2 II, OO; fig. 3 X.)

Holotype, ♂ (JC. 511.05001); allotype, ♀ (JC. 511. 05003). Paratopotypes: ♂, ♀, and ⊙ (JC. 511.05002,

511.05004–17, and 511.06001). All from Sorgono, Sardinia, where they were collected by Dr. Anton Krausse; labelled "13.4.1.2.30." All but specimens 511.05004 to 7 (2 ♂ and 2 ♀) are in collections of British Museum of Natural History; latter in author's collection.

Diagnosis. Both fixed and movable fingers, bearing 46–48 well-developed marginal teeth. Carapace subquadrate; two weakly developed eyes, which are more than a diameter from the anterior carapacal margin. Tergites with 11 or 12 and sternites with 12 or 13 marginal setæ. Palpus (fig. 3 X) robust, femur clearly granulate along its anterior face. Trochanter 2·2 to 2·3 times as long as broad; femur 2·9 to 3·1 times as long as broad, shorter than length of carapace; tibia strongly pedicellate, the pedicel measuring nearly a fourth of the total length of the segment, 2·1 to 2·3 times as long as broad; chela 2·8 to 3·1 times as long as broad; fingers slightly longer than hand. Length about 2·0 mm.

Remarks. It is possible that *abditus* represents an already described species, but this cannot be ascertained on the basis of the extant literature. The general systematic principle, that a synonym is a lesser taxonomic sin than a misdetermination, has been followed.

Subgenus Neobisium, typicus.

Genotype. *Obisium muscorum*, Leach.

Diagnosis and Remarks. Characterized in preceding key. Species clearly pertaining to this group as here defined are known from nearly the whole of Europe and middle eastern United States. A comprehensive and thorough revision of European, particularly southern European, species is badly needed.

Neobisium muscorum (Leach).

1817. *Obisium muscorum*, Leach, p. 51.
1911. *Obisium muscorum*, Leach, Kew, p. 54.
1928. *Obisium muscorum*, Leach, Kästner, p. 11.

Types. Deposited in the British Museum of Natural History, where they have been studied both by Cambridge and Kew.

Material examined. 2 ♀ (JC. 26.01001–2), Skäne, Skäralio, Sweden; exchange A. Tullgren. 1 ♀ (JC. 25.01001), Denmark; exchange Dr. Kai L. Henriksen. 1 ♀ (JC. 24.01001), Glogan, England; exchange British Museum. 1 ♂ (JC. 23.01002), "France"; exchange Dr. Louis Fage.

3 ♂, 3 ♀ (JC. 326.01001, "Bürgst bÿ Breda"; JC. 327. 01001, "Hilversum"; JC. 328.01001, "Aanspoelsel raeburg"; JC. 329.01001–3, "Diener"), Holland, from decaying leaves; examined through the courtesy of Dr. A. C. Oudemans.

Neobisium incertum, sp. n. (Fig. 1 K; fig. 2 EE.)

Holotype, ♂ (JC. 511.07001); allotype, ♀ (JC. 511. 07004); paratopotypes, ♂ and ♀ (JC. 511.06002–3 and 511.07005 to 15). Sorgono, Sardinia. Coll. Dr. Anton Krausse. Property of British Museum of Natural History, except paratypes, JC. 511.07005–9 (2 ♂ and 3 ♀), which are in the author's collection. Sixteen immature specimens (JC. 511.09001–16) collected at the same time and place are probably members of this species. Orginally misdetermined by myself (and so labelled in the case of the British Museum material) as *Obisium muscorum*, Leach.

Diagnosis. Fingers of chela subequal in length; marginal teeth normal on fixed finger, much reduced or obsolete on basal two-thirds of movable finger, contiguous and uniform in size. Carapace typical; espistomal process prominent. Palps robust and completely non-granulate. Trochanter normal; femur with a few scattered rounded protuberances, but otherwise smooth and polished, gradually swollen from base, attaining its greatest diameter $\frac{1}{3}$ its length from the tip, 3·6–4·0 times as long as broad; tibia very convex on inner margin, about 2·2 times as long as broad; chela 3·5 to 3·6 times as long as broad; fingers much longer than hand and shorter than femur, which is in turn shorter than the carapace. Length 2·6–3·0 mm.

Remarks. Closely similar in many ways to *Neobisium erythrodactylum* (L. Koch). The tibia, however, is very much more convex on the inner margin, and the chela is unicolorous.

Neobisium inæqualum, sp. n.

Holotype, ♂ (JC. 13.01010); allotype, ♀ (JC. 13. 01002); paratopotypes, 3 ♂ and 5 ♀ (JC. 13.01001 and 13.01003–9 and 11–12). All from "Hungary orientalis," Europe. Received from Dr. Chas. Sajo of Oersentmiklos.

Diagnosis. Fingers of chela clearly unequal in length, the movable finger being distinctly the longer; marginal teeth best developed on fixed finger, low and poorly developed on basal $\frac{2}{3}$ of movable finger, subcontiguous and of uniform size (*i. e.*, large teeth not alternating with several smaller

ones). Carapace typical; epistomal process well defined, anterior eyes ½ diameter from anterior margin of carapace and ⅕ diameter from posterior pair. Palps robust, tibia and chela prominently pedicellate; non-granulate. Trochanter with rounded tubercle behind; femur not pedicellate, gradually enlarging in diameter to near its tip, about 1·5 times as long as carapace and 4·3 to 4·6 times as long as broad; tibial pedicel much longer than broad; tibia exteriorly slightly convex, interior strongly swollen medianally, with a slight concavity distally, 2·5 to 2·7 times as long as broad; chela unusually broad at base of fingers, so that latter appear to arise from a subtruncate base; pedicel as long as broad; hand egg-shaped and subequally expanded interiorly and exteriorly, 3·6 to 3·7 times as broad as long (length taken to tip of *fixed* finger); fingers clearly longer than hand, movable finger much longer than fixed finger. Tergites with about 14, sternites with about 20, marginal setæ. Length about 3·0 mm.

Remarks. Apparently related to *Neobisium elimatum* (C. Koch), which it resembles in the unequal fingers of the chela. It seems to differ therefrom in larger size, more pedicellate chela and tibia, and in the broader carapace.

Neobisium sp. indet.

Material examined. 1 ♂ (JC. 23.01001); France, exchange from M. Louis Fage.

Remarks. This species when received was erroneously determined as *muscorum* (Leach), probably by Simon. It may be *carpenteri* (Kew) or *simile* (L. Koch). Kew (1911, p. 54, footnote 2) has already shown that Simon had confused these three forms. The specimen before me is in too poor condition to permit a definite conclusion.

Neobisium carolinensis (Banks).
(Figs. 2 G, M, W; figs. 3 A, D.)

1895. *Obisium carolinensis*, Banks, p. 12.

Material examined. North Carolina: Frying Pan Gap, Mt. Pisgáh ‡, 1 (JC. 317.01001). Mt. Pisgáh ‡, 10.14.1926, 5 (JC. 315.01001–5). Headwaters, East Fork of Pisgáh River ‡, 10.14 1926, 1 (JC. 319.01001). Grandfather Mountain †, 10.12.1923, 13 (JC. 302.01001–13). Summit of Mt. Mitchell †, 10.22.1923, 25 (JC. 318.02001–25). Blowing Rock †, 10.10.1923, 3 (JC. 303.01001–3). Black Mountains †, 5 (JC. 14.01001–5), coll. R. V. Chamberlin. Montreat *, 10.16.1923, 11 (JC. 316.01001–11). Mt. Pisgáh ‡, Oct. 1923, 10 (JC. 304.01001–10). Nantahala Gap ‡, Macon

dagger (‡) are probably more similar to *tenuis* than to the typical variety, but apparently represent true intergrades. Much further study will be required before the real status of this "species" can be ascertained.

Neobisium (?) sp. indet.

Material examined. 8, apparently all immature (JC. 307.01001–8), Quicksand, Kentucky, June 25, 1925. Coll. C. R. Crosby.

Remarks. This puzzling collection is doubtfully referred to the present genus and subgenus. In view of the apparent immaturity of all the specimens even this cannot be ascertained with certainty.

Subgenus PAROBISIUM, nov.

Orthotype. *Neobisium* (*Parobisium*) *magnum*, sp. n.

Diagnosis and Remarks. Characterized in the key.

In addition to the forms here described it is quite likely that the following species also pertain to this group:—"*Obisium japonicum*, Ellingsen; *Obisium pygmæum*, Ellingsen; and *Obisium brevifemoratum*, Ellingsen. However, if Ellingsen's opinion as to the very close relation between the last two of these three species and *Microbisium parvulum* (Banks) be sustained, it will be necessary to refer these two at least to *Microbisium*, gen. nov. A decision cannot be rendered in the absence of material.

Key to the Species of Parobisium.

1. Fingers of chela subequal in length to hand; movable finger of chela with 70 marginal teeth at most .... 2.
   Fingers of chela clearly much longer than hand; movable finger of chela with at least 85 marginal teeth 3
2. Posterior margin of carapace with 10 marginal setæ; tergites with 16–18 marginal setæ: large species, 4·5 to 5·0 mm.; from Japan .... *magnum*, sp. n.
   Posterior margin of carapace with 8 marginal setæ; tergites with 10–12 marginal setæ: smaller species, 2·5 mm.; from Japan .... *flexifemoratum*, sp. n.
3. Femur strongly but evenly granulate along its anterior face and 4·3 (in female) times as long as broad; palm of chelicera with eight setæ: from Oregon .... *hesperum*, sp. n.
   Femur at most weakly granulate along its anterior face, and 3·8 (young female) times as long as broad; palm of chelicera with six setæ: from Japan .... *imperfectum*, sp. n.

Neobisium (*Parobisium*) *magnum*, sp. n.

Holotype, ♀ (JC. 389.01001). Coll. F. Silvestri, Oct. 31, 1924, at Moghi (Kyushu), Japan. No further material.

Diagnosis. Sclerotic parts smooth and polished. Fixed finger of chela with 60 marginal teeth; movable finger with 68–70. Carapace subquadrate, with blunt epistomal process; with four large eyes, the anterior pair of which is 1 diameter from the anterior carapacal margin and ⅓ diameter from the posterior pair; chætotaxy 4–10 (26). Tergites with 16–18 and sternites with 16–20 marginal setæ. Spinneret weakly if at all developed; palm of chelicera with 7 setæ. Palpi robust. Trochanter 1·8–1·9 times as long as broad; femur 3·2 times as long as broad, finely granulate along its anterior margin and broadest distally; tibia strongly pedicellate, 2·1 times as long as broad; chela 2·5 times as long as broad; fingers subequal in length to hand. Fingers gape slightly in female at least. Length of expanded female 5·0 mm.

Neobisium (*Parobisium*) *flexifemoratum*, sp. n.

Holotype, ♀ (JC. 325.01001); paratype, ♀ (JC. 325. 01002). Muchogo-o (?), Japan. Coll. June 3, 1925, by Dr. F. Silvestri.

Diagnosis. Sclerotic parts smooth except for the anterior face of the femur, which is finely but evenly granulate. Fixed finger with 49–50, movable finger with 54–56 marginal teeth. Carapace subquadrate, epistomal process obsolete; eyes greatly reduced and apparently absent in some cases (apparently absent in the holotype; four very weakly differentiated eye-spots in paratype); chætotaxy 4–8 (26). Tergites and sternites with 10–12 marginal setæ. Chelicerae more delicately formed than in *magnum*; spinneret present as a low but distinct sclerotic crest; palm with 7 setæ. Palps robust. Trochanter 1·9 times as long as broad; femur 2·6–2·7 times as long as broad, anteriorly slightly granulate, broadest basally; tibia strongly pedicellate, 2·0 times as long as broad; chela 2·7 times as long as broad; fingers subequal in length to hand. Length 2·5 mm.

Remarks. Apparently rather close to "*Obisium*" *pygmæum*, Ellingsen, from which it differs in its larger size, the presence of a clearly developed spinneret, the slightly stouter and clearly curved femur. In *pygmæum* the femur is described as "robust, with a short, robust but distinct stalk, the inner side slightly convex or nearly straight, femur on the whole nearly parallel-sided, straight, not curved."

In *flexifemoratum* it is anteriorly strongly convex and distally concave; exteriorly and basally strongly swollen, slightly concave medianally and strongly inflected distally.

Neobisium (*Parobisium*) *imperfectum*, sp. n.

Holotype, an apparently immature or young female (JC. 325.02001). From same vial of material as *flexifemoratum*. Muchigo-o (?), Japan. Coll. June 3, 1925, by Dr. F. Silvestri.

Diagnosis. Sclerotic parts uniformly smooth. Fixed finger of chela with 76, movable finger with 86 marginal teeth. Carapace much longer than broad, anteriorly somewhat produced and with a weak epistomal process; two pairs of weakly developed eyes, the anterior pair of which is nearly 2 diameters from the anterior carapacal margin and about ½ diameter from the posterior pair; chætotaxy 4–8 (26). Tergites with 11 or 12 and sternites with 14 or 15 marginal setæ. Cheliceræ slender; spinneret a longitudinal sclerotic crest as in *flexifemoratum*; palm with six setæ. Palps slender. Trochanter 2·0–2·1 times as long as broad femur weakly pedicellate and gently clavate, 3·8 times as long as broad; tibia weakly pedicellate and 2·5 times as long as broad; chela 3·4 times as long as broad; fingers much (1·2 times) longer than hand. Length 3·5 mm.

Remarks. The immaturity of the holotype is inferred from the fact that the chætotaxy of the chela is defective, SB and ISB being absent. Nevertheless, other characteristics make the generic and subgeneric placing certain. In the genus *Microbisium*, which normally possesses a reduced chætotaxy in the adult stage, the missing setæ are SB and IST; also the apical maxillary setæ number 3 instead of 4 as in the present species.

All things considered, this species seems most closely related to the American species *hesperum*, nov.

Neobisium (*Parobisium*) *hesperum*, sp. n.

Holotype, ♀ (JC. 454.01001). Cannon Beach, Oregon. Collected July 15, 1927, in the rubble beneath a log above the high-tide line, by Dr. E. C. Van Dyke.

Diagnosis. Fingers of chela with about 86–88 marginal teeth each. Carapace longer than broad, epistomal process absent; eyes 2, weakly developed, and nearly two ocular diameters from the anterior carapacal margin; chætotaxy 4–6 (24). Tergites with about 12 and sternites with 18 marginal setæ. Cheliceræ slender; spinneret present as a short, somewhat translucent, sclerotic process; palm with 8 setæ. Palps slender. Trochanter showing traces of weak granulation, straight behind, 2·7 times as long as broad; femur strongly but evenly granulate, gently clavate, and broadest distally, 4·3 times as long as broad; tibia smooth,

slenderly pedicellate, and gently bilaterally convex, 3·1 times as long as broad; chela obovate basally, fingers longer than hand; chela as a whole 3·2 times as long as broad. Length 5·0 mm.

Genus MICROBISIUM, nov.

Orthotype. *Obisium brunneum*, Hagen.

Diagnosis and Remarks. Characterized in key. Interesting because of the small sizes of the included forms and the fact that males are apparently normally absent (at least, so far as can be ascertained from non-histological studies). It is interesting to speculate as to whether or not this signifies parthenogenesis. In addition to the two species here recorded from the United States, "*Obisium*" *brevipalpe*, Redikorzev, from Kamchatka, seems almost certainly to pertain to this genus.

Ellingsen (1909, p. 220), in reporting upon a collection of material from North America, recorded *parvulum*, Banks, with the comment that it was very similar to his *brevifemoratum* and *pygmæum* from Norway and Japan respectively, and suggested further that they all possibly represented the same species. This may be true, although I am personally more inclined to believe that Ellingsen's species are valid and pertain to *Parobisium*. This point cannot be settled until the species in question are re-studied.

Two North American species definitely pertain to this interesting group. They may be separated by means of the following couplet:—

1. Fingers clearly longer than the hand (1·1 to 1·3 times as long); femur 2·9–3·2 times as long as broad .... *brunneum* (Hagen).
   Fingers subequal in length to hand (0·97 to 1·03 times as long); femur 2·6 to 2·8 times as long as broad........................ *parvulum* (Banks).

Microbisium brunneum (Hagen).

1869. *Obisium brunneum*, Hagen, p. 52.
1895. *Obisium brunneum*, Hagen, Banks, p. 12.

Types. Hagen's original material was from Massachusetts. It is probably preserved in the Museum of Comparative Zoology.

Determination. The determination of this form is probably correct, in spite of Hagen's insufficient original description.

Material examined. Maine: 1 immature ♀ (JC. 394.01001), Presque Isle.

New York: 13 ♀ (JC. 30.01001–13), Cortland County; Labrador Pond. 1 ♀ (JC. 47.01001), Eglestons Glen, Yates County. 2 immature ♀ (JC. 51.01001 and 380.01001), Ithaca. 3 ♀ (JC. 50.01001–2 and 21.01001), Freeville. 2 ♀ (JC. 45.01001–2), Wilmington Notch, Essex County. 5 ♀ (JC. 377.01001–5), Suffexn, Ramapo Mts. 1 ♀ (JC. 385.01001), from *Woodwardia* swamp, Freeville. 5 ♀, 4 immature (JC. 381.01001–9), Cinnamon Lake, Schuyler County. 6 ♀ (JC. 298.02001–6), Sea Cliff (collected by R. V. Chamberlin). 4 ♀ (JC. 49.01001–4), sifted from moss, Ringwood, Tomkins County. 4 ♀ (JC. 378.01001–4), Montauk Point. 4 ♀ (JC. 379.01001–4), Howard. 1 young ♀ (JC. 382.01001), West Barre. 2 immature ♀ (JC. 387.01001–2), Tuxedo. 3 ♀ (very poor condition) (JC. 48.01001–3), Enfield Glen, Ithaca (determination doubtful). 1 immature (JC. 41.01001), Penn Yan (determination doubtful). 2 ♀ (JC. 383.01001–2). 6 ♀ from Heath Bog (JC. 384.01001–6), and 3 ♀ (one with discal mass of 13 normally attached eggs) (JC. 396.01001–3), McLean.

Missouri: 4 ♀ (JC. 33.01001–4), Columbia.

Ohio: 4 ♀ (JC. 404.01001–4), "southern part of state."

Virginia: 1 immature (JC. 400·01001), Alberta (determination doubtful).

Washington, D.C.: 4 apparently immature (JC. 332.01001–4), coll. H. C. Barber (determination doubtful; Crosby material).

Georgia: 2 very young (JC. 43.01001–2), Billy's Island, Okefinokee Swamp (determination doubtful).

Locality unknown (presumably eastern United States): 1 specimen (JC. 29.01001), from type-collection of *Obisium parvulum*, Banks, and labelled "co-type," proves to be the present species. 3 ♀ (JC. 405.01001–3).

Unless otherwise indicated, Dr. C. R. Crosby was the collector of the foregoing material. Specimens in Cornell University and author's collections.

Remarks. Occasionally found in company with *parvulum*, from which it is readily separated by the characters given in the key.

Microbisium parvulum (Banks).

1895. *Obisium parvulum*, Banks, p. 12.
1909. *Obisium parvulum*, Banks, Ellingsen, p. 220.

Types. Deposited in the collections of the Museum of Comparative Zoology. Type-locality unknown. Banks

suggests Florida as the likely source. From other considerations (of relative distribution) I believe that somewhere in the middle north-east or west is more likely. A so-called co-type of this species (JC. 29.01001), which I have had the privilege of examining, proves to be a typical specimen of *brunneum* (Hagen). In the absence of the balance of Banks's original material, it is impossible to say whether his species will fall as a synonym or not. But since specimens are available which clearly fit his description of *parvulum* and differ from typical *brunneum*, it seems likely that his type-material contained representatives of both species.

Material examined. North Carolina: 3 ♀ and 1 immature (JC. 333.01001–4), Mt. Pisgáh (3000 feet elevation), collected 10.19.1923 by C. R. Crosby.

New York: 2 ♀ (JC. 433.02001–2); 1 ♀ (JC. 52.01001), Ithaca (Fall Creek), collected 7.30.1909 by R. V. Chamberlin. 6 ♀ (JC. 396.02001–6), 5.16.1925, and 1 ♀ (JC. 386.01001), in "Heath bog," 5.30.1921, collected by C. R. Crosby, McLean.

Minnesota: 3 ♀ (JC. 395.01001–2 & 395.02001), collected June 22 and July 17, 1924, respectively, by F. C. Fletcher (Crosby-Cornell Collection), Lake Minnetonka.

Colorado: 1 ♀ (JC. 87.01001), from "surface soil or pine duff beneath douglas fir," and 1 ♀ (JC. 89.01001), from "under scrub-oak chapparal in almost pure gravel"; both lots collected by Dr. E. W. Goldsmith from near Alpine Laboratory, Engleman Canyon, Manitou.

Utah: 17 ♀ (JC. 6.01001–17), collected by author and others from damp soil beneath decaying lawn-grass clippings; in small cavities in the soil; city lot near Liberty Park, Salt Lake City.

Material in author's and Cornell University Collections.

Remarks. The Utah and Colorado material seems typical in every way.

Subfamily *Ideobisiinæ*, nov.

1891. *Pseudobisiidæ*, L. Balzan, p. 504.
1906. *Pseudobisiinæ*, Hansen, C. With, p. 77.

Type. Genus *Ideobisium*, Balzan.

Diagnosis and Remarks. Characterized in key. Includes three well-marked genera, which are diagnosed in the key. The geographic range of the subfamily as a whole is cosmopolitan, but predominantly northern. The old subfamily name Pseudobisiinæ is untenable, since there is no genus *Pseudobisium*.

Analytical Key to the Genera of the Ideobisiinæ.

1. Maxillaris apicalis acute, with two slender apical setæ (fig. 2 X); T, ST, and SB of movable finger submedianally clustered and scarcely or not at all a single areolar diameter apart .... *Ideobisium*, Balzan, p. 36.

   Maxillaris apicalis strongly rounded, short, with 3–5 apical setæ (fig. 2 W); chætotaxy of movable finger of chela not as above .... 2.

2. Spinneret a row of 8–10 stylet-like galeæ (fig. 1 P); setæ large and conspicuous, there being 20–22 marginal tergal setæ; no tactile setæ on distal third of fingers .... *Halobisium*, gen. nov., [p. 35.

   Spinneret a single simple or branched galea; setæ inconspicuous, there being at most about 12 marginal tergal setæ; at least one or two tactile setæ situated on distal third of fingers (fig. 3 B)........................ *Microcreagris*, Balzan, [p. 23.

Genus Microcreagris, L. Balzan.

1891. *Microcreagris*, L. Balzan, p. 543.

Type. *Microcreagris gigas*, L. Balzan.

Remarks. As originally defined, *Microcreagris* merged imperceptibly into *Ideobisium*. As here delimited it is a compact and homogeneous group, which includes not only all those species previously described under its head, but most of those described under *Ideobisium* as well. It is evidently a large genus. Seventeen species, most of which are undescribed, are represented in collections now before me.

The genus seems to be truly Holarctic, reaching its maximum development in China, Japan, and the Pacific coast of North America.

The following artificial key will facilitate specific determinations. It is obviously incomplete :—

Key to certain Species of Microcreagris.

1. Fingers "about"* the same length as the hand .... 2.

   Fingers either longer or shorter than hand .... 3.

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* It cannot be clearly ascertained from the literature just how the relative lengths of finger and hand were taken. It is possible that remeasurement, on the basis of the method here followed, would alter the ratio given in either direction—hence this precaution.

2. Giant species, 7·1 mm. long: femur of palps smooth; cheliceræ longer than carapace, which possesses a strongly developed epistomal process; with 4 prominent eyes: from China ...... *gigas*, L. Balzan, p. 28.
Small species, 2·5 mm. long: femur of palps strongly granulate; cheliceræ much shorter than carapace, which possesses a moderately developed epistomal process; with 2 eyes: from Europe .... *cambridgei* (L. Koch), [p. 30.
3. Fingers of chela clearly shorter than hand (if small European or giant Chinese species, see also couplet 2 *). 4.
Fingers of chela clearly longer than hand (if small European or giant Chinese species, see also couplet 2 *) ...... 7.
4. Large species (6·5 mm.): from California. *magnum* (Banks), p. 28.
Smaller species (5·0 mm. or less): from the Orient .... 5.
5. Fingers of chela longer than carapace; chela thrice as long as broad: from Tibet .... *kaznakovi*, Redikorzev, [p. 28.
Fingers of chela shorter than carapace; chela distinctly less than three times as long as broad: from China or Japan .... 6.
6. Tibia shorter than hand; fingers no longer than breadth of chela; with 4 apical maxillary setæ; marginal teeth of fingers of chela 35–40 .... *brevidigitata*, sp. n., p. 26.
Tibia longer than hand; fingers much longer than breadth of chela; with 5 apical maxillary setæ; marginal teeth of fingers of chela 65–75 .... *silvestrii*, sp. n., p. 27.
7. Palps at least slightly (generally quite conspicuously) granulate, especially along the anterior femoral margin .. 12.
Palps quite smooth, including the anterior femoral margin .... 8.
8. Femur subclavate, attaining its greatest diameter at least slightly anterior of median: western American species.. 9.
Femur clearly broadest on its basal half, becoming thereafter gradually and progressively attenuate distally: eastern American or Oriental species. 10.
9. IT clearly posterior to and hence posteriorly oblique with ET (fig. 3 F); apical maxillary setæ normally 3 (rarely reduced to 2): small species, 3·5 mm. long .... *cingara*, sp. n., p. 29.

* It cannot be clearly ascertained from the literature just how the relative lengths of finger and hand were taken It is possible that remeasurement, on the basis of the method here followed, would alter the ratio given in either direction—hence this precaution.

IT even with ET, both the same distance from apex of finger; apical maxillary setæ normally 5 (may be reduced to 4 in immature specimens): large species, 5–6 mm. long .... *sequoiæ*, sp. n., p. 28.

10. IT clearly anterior to ET, and hence anteriorly oblique therewith; apical maxillary setæ 5 .... *japonica*, Ellingsen, p. 28.

IT clearly posterior to ET, and hence posteriorly oblique therewith (fig. 3 F, B, etc.); apical maxillary setæ 3 or 4 .... 11.

11. T and ST only 2 or 3 areolar diameters apart; ST situated ⅓ closer to T than SB; femur 2·4 to 2·7 times as long as broad and anteriorly very finely granulate, as may readily be seen by close inspection: small Oriental species, about 2·0 mm. long........ *formosana*, Ellingsen, p. 30.

T and ST 4 or 5 areolar diameters apart; ST situated only slightly nearer T than SB; femur 3·0–3·1 times as long as broad and completely smooth: larger eastern United States species, about 3·0 mm. long .... *atlantica*, sp. n., p. 29.

12. Femur strongly pedicellate and non-clavate, broadest just beyond pedicel. *formosana*, Ellingsen *, [p. 30.

Femur weakly pedicellate and clearly clavate in general appearance, attaining its greatest breadth submedially or distad thereof .... 13.

13. Posterior margin of carapace with 8 or 9 setæ: Oriental species .... 14.

Posterior margin of carapace with 6 border-setæ: western American species .... 15.

14. Tibia stoutly pedicellate, the pedicel itself no longer than its own greatest width (fig. 3 R); trochanter 1·9 to 2·0 times as long as broad......... *orientalis*, sp. n., p. 34.

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* *Formosana*, Ellingsen, may be readily separated from *cambridgei* (L. Koch), which it much resembles in certain respects, by means of the following couplet (see also couplet 2):—

12 *a*. IT clearly closer to EST than ET, being much more distant from the apex of the finger than the former (fig. 3 B); 2 eyes; femur prominently granulate: from England .... *cambridgei* (L. Koch), [p. 30.

IT closer to ET than EST, being scarcely more distant from apex of finger than the former (fig. 3 F); 4 weak eyes; femur inconspicuously granulate: Oriental species .... *formosana*, Ellingsen, p. 30.

Tibia slenderly pedicellate, the pedicel itself clearly much longer than its own greatest width (fig. 3 U); trochanter 2·2–2·3 times as long as broad .... *lampra*, sp. n., p. 34.

15. Tibia elongate, 3 or more times as long as broad in male and 2·8 times or more as long as broad in female .... 16.

Tibia plainly stouter than indicated above—no more than 2·7 times as long as broad in male, and correspondingly stouter in female .... 17.

16. Trochanter with two small but distinct, widely separated, rounded eminences behind; femur of male 4·3 to 4·5 times as long as broad; tibia of male 3·4 to 3·5 times as long as broad; length of male 3·0–3·5 mm. .... *hespera*, sp. n., p. 31.

Trochanter with inconspicuous irregularities behind, but not as in *hespera*; femur of male at most 4·0–4·1 times as long as broad; tibia of male at most 2·9–3·0 times as long as broad; male 2·0–2·5 mm. long .... *duncani*, sp. n., p. 33.

17. Tibia clearly longer than fingers of chela; EB and ESB arising from summits of small rounded tubercles: from eastern United States .... *rufulum* (Banks), p. 30.

Tibia barely equal to or shorter than fingers of chela; EB and ESB not arising from the summits of tubercles: from western United States ...... 18.

18. Fingers of chela subequal to tibia in length .... 19.

Fingers of chela clearly longer than tibia. 20.

19. Chela of female 3·0–3·1 times as long as broad; tibia 2·5 times as long as broad; carapace clearly longer than tibia; female 3·5 mm. long .... *thermophila*, sp. n., p. 32.

Chela of male 3·8 times as long as broad; tibia 2·7 times as long as broad; carapace and tibia subequal in length; male 1·9–2·0 mm. long .... *lauræ*, sp. n., p. 32.

20. Femur 3·6 times as long as broad; tibia 2·3–2·5 times as long as broad; chela 2·8–2·9 times as long as broad; male about 3·0 mm. long .... *phyllisæ*, sp. n., p. 31.

Femur 3·1–3·7 times as long as broad; tibia 2·6–2·8 times as long as broad; chela 3·3–3·7 times as long as broad; 2·0–2·8 mm. long .... *macilentum* (Simon), p. 31.

Microcreagris brevidigitata, sp. n.

Holotype, ♀ (JC. 390.01001), Mte. Kirishima, Japan. Coll. ix.20.1924 by Dr. Silvestri.

Diagnosis. Movable finger of chela with 40–42 and fixed finger with 33 or 34 marginal teeth. Carapace little if any longer than broad, with two pairs of weakly developed eyes, of which the anterior pair is about ¼ ocular diameter from the posterior pair and 1·5–2·0 diameters from the anterior carapacal margin, which bears a weakly developed epistomal process; chætotaxy 4–10 (28). Apical maxillary setæ 4. Tergites with 13 or 14 and sternites with 16–18 marginal setæ; no discal setæ on sternites. Palps short and robust and nearly smooth. Trochanter 1·8 times as long as broad; femur attaining its greatest diameter ⅓ length from base, weakly granulate along its anterior margin, and 2·4 times as long as broad; tibia stoutly pedicellate, the pedicel itself as broad as long, 1·9 times as long as broad; chela 2·3 times as long as broad; hand 1·7 times as long as the short stubby fingers, which are no longer at most than breadth of hand. Length 3·5 mm.

Microcreagris silvestrii, sp. n.

Holotype, ♂ (JC. 399.01001), Ychyhan (China ?); coll. x.24.1925. Paratopotypes, 4 ♂, same collection data (JC. 399.01002–5).

Diagnosis. Chela with 80–85 marginal teeth on movable and 67–73 on fixed finger. Carapace quadrate, with two pairs of well-developed eyes, the anterior pair of which is ¾ ocular diameter removed from the posterior pair and over a diameter from the anterior carapacal margin, which bears a weakly developed epistomal process; chætotaxy 6–9 (32–33). Apical maxillary setæ 5. Tergites with 14 or 15 and sternites with a similar number of marginal setæ; sternites without differentiated discal setæ. Palps moderately stout and largely smooth. Trochanter with well-developed conical protuberance behind, 1·7 times as long as broad; femur broadest submedianally, completely smooth except for a few scattered rounded tubercles, 3·0–3·1 times as long as broad; tibia stoutly pedicellate, pedicel itself as long as broad, 2·1–2·2 times as long as broad; chela 2·4–2·6 times as long as broad; fingers clearly shorter than hand, but much longer than its breadth. Length of male about 4·0 mm.

Remarks. The holotype shows a very interesting abnormality in the abdominal segmentation. The tergites are completely normal in appearance, but the left half of the seventh sternite only is present. Medianally the fragmentary sternite "pinches out," and the right side possesses no trace of the missing part.

Microcreagris magnum (Banks).

1909. *Ideobisium magnum*, Banks, p. 306.

Remarks. I have not seen material of this species, which is undoubtedly a member of the present genus. If Banks's description is correct, it is the only American member of the genus which possesses chelal fingers which are shorter than the hand.

Microcreagris kaznakovi, Redikorzev.

1918. *Ideobisium* (*Microcreagris*) *kaznakovi*, Redikorzev, p. 97, figs.

Remarks. I have not seen material of this species. Redikorzev's description is adequate. It should be easily determined on the basis of the characters given in the key.

Microcreagris gigas, L. Balzan.

1891. *Microcreagris gigas*, L. Bazan, p. 544.

Remarks. I have not seen material of this species. It is interesting principally as the type of the genus. Its large size and enormous cheliceræ should render it readily recognizable.

Microcreagris japonica, Ellingsen. (Fig. 2 BB.)

1907. *Microcreagris gigas*, var. *japonica*, Ellingsen, p. 7.

Material examined. 1 ♂ (JC. 517.01001), coll. by S. Akiyama at Idzu, Japan, June 1910. Deposited in British Museum of Natural History. 1 ♂ (JC. 388,01001), Chofu, China. Coll. xi.11.1924, by Dr. F. Silvestri.

Remarks. Although Ellingsen's characterization of this form is brief, I believe the determination to be correct. I cannot agree with Ellingsen that the species is a "form" of *gigas*.

Microcreagris sequoiæ, sp. n.

Holotype, ♂ (JC. 570.01001), sifted, together with an immature specimen (JC. 570.01002), from rotting leaves in a grove of redwoods (*Sequoia sempervirens*), by author, ix.7.1927; Muir Woods, Marin County, California.

Additional Material. A badly damaged female (JC. 22.01001), collected by Dr. F. R. Blaisdell, vi.16.1922, at Willow Creek, Humboldt County, California, probably pertains to this species.

Diagnosis. Chela with about 65 marginal teeth on movable and 70 on fixed fingers. Carapace subquadrate, with two pairs of well-developed eyes, the anterior pair of which is about ½ ocular diameters from the posterior pair and about 1 diameter from the anterior carapacal margin, which bears

a well-developed epistomal process; chætotaxy 4–6 (24). Apical maxillary setæ 5. Tergites with about 12 and sternites with about 16 marginal setæ; sternites 7 and 8 with a weakly differentiated median pair of discal setæ. Palps robust and non-granulate. Trochanter with one or two weak apical protuberances behind, 1·7 times as long as broad; femur smoothly clavate, broadest distally, 3·4 times as long as broad; tibia stoutly pedicellate, the pedicel no longer than broad, 2·3 times as long as broad; chela thrice as long as broad; fingers slightly but distinctly longer than hand. Large species, ♂ 5 mm. long.

Microcreagris cingara, sp. n. (Fig. 2 GG; figs. 3 F, R.)

Holotype, ♂ (JC. 245.02001); allotype, ♀ (JC.245.02002); paratopotypes, 2 ♀, 1 immature (JC. 245.02005–7). All collected iii.19.1924, by Dr. Vasco Tanner at St. George, Utah.

Additional Material. 1 ♀ (JC. 436.01001), coll. xi.24.1927 by D. T. Jones as Springfield, Oregon, seems to pertain to this species. The carapace is scarcely if at all longer than broad, and the femur is broadest somewhat more basally than in the type. Otherwise typical.

Diagnosis. Chela with 55–60 marginal teeth on movable and 60 on fixed finger. Carapace a little longer than broad, with two well-developed pairs of eyes, the anterior pair of which is ½ ocular diameters from the posterior pair and 1 diameter from the anterior carapacal margin, which bears a moderately developed epistomal process; chætotaxy 4–6 (24–26). Apical maxillary setæ 2 or 3. Tergites with 12 and sternites with about 15–16 marginal setæ; sternites 7 and 8 with a weakly differentiated pair of median discal setæ. Palps robust and non-granulate. Trochanter almost or quite evenly convex behind, 1·6–1·8 times as long as broad; femur broadest distally, clavate in appearance, and 3·0–3·3 times as long as broad; tibia stoutly pedicellate, the pedicel no longer than broad, 2·1–2·2 times as long as broad; chela 2·7–2·8 times as long as broad; fingers clearly longer than hand. Length 3·5–4·0 mm.

Microcreagris atlantica, sp. n.

Holotype, ♂ (JC. 434.01001); allotype, ♀ (JC. 434.01002). Both from an unlabelled vial included in a general collection of material from the eastern United States, as collected by Dr. R. V. Chamberlin. Paratype, 1 ♀ (JC. 262.01001), "probably from Asheville," North Carolina. Coll. R. V. Chamberlin.

Diagnosis. Chela with 51–54 marginal teeth on movable

and 45–48 on fixed fingers. Carapace clearly longer than broad, with two pairs of eyes, the anterior pair of which is less than ½ ocular diameter from the posterior pair and 1 diameter from the anterior carapacal margin, which possesses a well-developed epistomal process; chætotaxy 4–5 or 6 (26). Apical maxillary setæ 4. Tergites with about 12 and sternites with the same number of marginal setæ; sternites without discal setæ. Palpus medium in build and completely smooth. Trochanter with a small rounded protuberance behind, 1·7–1·9 times as long as broad; femur broadest about medianally, clearly pedicellate, and 3·0–3·1 times as long as broad; tibia with robust pedicel, which is clearly as broad as long, 2·1 to 2·3 times as long as broad; chela rather strongly swollen on inner face, 2·8 to 2·9 times as long as broad; fingers very clearly longer than hand. Length 2·3 to 2·8 mm.

Microcreagris formosana, Ellingsen.

1912 (*b*). *Microcreagris granulata*, var. *formosana*, Ellingsen, p. 127.

Material examined. 2 ♀ (JC. 558.01001–2). Labelled simply "*Microcreagris granulata*, Ellingsen, var." The source of this material is not now known to me, but it was received in exchange. This is almost surely a part of Ellingsen's original collection of some 50 specimens from Takao, Formosa.

1 ♀ (JC. 550.02001), coll. C. F. Baker. Mt. Makiling, Luzon, Philippine Islands.

Remarks. The characters given in the key to the species will amply supplement Ellingsen's scanty original data. I feel quite sure that the determination is correct.

Microcreagris cambridgei (L. Koch).

1873. *Roncus cambridgei*, L. Koch, p. 45.
1911. *Obisium* (*Ideoroncus*) *cambridgei*, Koch, Kew, p. 53.

Material examined. A single ♀ in poor condition (JC. 28.01001), from Devon, England, is at hand. Exchange from the British Museum of Natural History.

Microcreagris rufulum (Banks).

1891. *Obisium rufulum*, Banks, p. 166.
1895. *Ideobisium rufulum* (Banks), Banks, p. 11.

Material examined. 2 ♂, 1 ♀, and 1 ⊙ (JC. 7.01001–4), coll. iv.18 (year unknown), at Glen Sligoe, near Washington, D.C; 2 ♂ (JC. 296.02001–2), from Washington, D.C.; 19 ♂ and ♀ (JC. 3.02001–18), Falls Church, Virginia; 1 ♀ (X. 406.01001), v. 1 (year unknown), Great Falls, Virginia. All except first lot from Dr. R. V. Chamberlin.

Microcreagris hespera, sp. n. (Fig. 3 U.)

Holotype, ♂ (JC. 451.01001), Pepperwood Creek, near mouth of Gualala River, Mendocino County, California; coll. viii.24.1928, by B. C. Cain. Paratype, ♂ (JC. 15.01001), Berkeley, California; coll. Dietrich; loan from Cornell University..

Diagnosis. Chela with 79 teeth on movable and 77 on fixed finger. Carapace longer than broad; apparently completely eyeless; without epistomal process; chætotaxy 4–6 (22). Tergites with about 10, sternites with about 12 border-setæ; sternites 7–9 with a submedian pair of clearly differentiated discal setæ. Maxilla with 3 apical setæ. Palpi extremely long and slender, and conspicuously but evenly granulate. Trochanter with an anterior and posterior rounded tubercle behind, 2·6 times as long as broad; femur attenuate, broadest near tip, 4·4 times as long as broad; tibia with a long and slender pedicel, clearly much longer than broad, 3·4 times as long as broad; chela attenuate, fingers greatly longer than hand and nearly four (3·9) times as long as broad. Length of male 3·5 mm.

Microcreagris macilentum (E. Simon).

1878. *Obisium macilentum*, E. Simon, p. 157.

Material examined. ♂ (JC. 529.01001), 9 ♂ and ♀ (JC. 529.01003–11), and 1 ♂ and 3 ♀ (JC. 54.01001–4). All from Claremont, California. Other collection-data unknown.

Remarks. This determination is probably correct. Dr. Louis Fage has kindly compared one of my specimens (JC. 54.01002) with the type, and verifies my conclusion.

Microcreagris phyllisæ, sp. n.

Holotype, ♂ (JC. 376.01001), Coronado, California, on beach in kelp; coll. by Dr. F. R. Blaisdell, i.19.1928. Paratype, ♂ (JC. 9.01001), Eaton's Cave, Los Angeles County, California, May 1913; from R. V. Chamberlin.

Diagnosis. Movable finger of chela with 52 and fixed finger with a similar number of marginal teeth. Carapace scarcely longer than broad, with two pairs of well-developed eyes, the anterior pair of which is about ⅓ ocular diameter from the posterior pair and a scant diameter from the anterior carapacal margin; epistomal process well developed; chætotaxy 4–6 (26). Apical maxillary setæ 4–5. Tergites with 12 and sternites with 16 marginal setæ; sternites 6–8 with a

submedian pair of clearly differentiated discal setæ. Palps slender and clearly granulate. Trochanter with median rounded protuberance behind, granulate, and 2·1 times as long as broad; femur evenly granulate, gradually enlarged from pedicel to near tip, and 3·5–3·6 times as long as broad; tibia with slender pedicel, which is clearly longer than broad, granulate, and 2·4–2·5 times as long as broad; chela slender, 3·0–3·2 times as long as broad; fingers much longer than hand. Length of male 3·2 mm.

Remarks. Named for Phyllis Chamberlin.

Microcreagris thermophila, sp. n.

Holotype, ♀ (JC. 547.01001); paratype, ♀ (JC. 547. 01002). Under stones on desert hillside, Box Springs Grade, near Riverside, California. Coll. xi.1925, by the author.

Diagnosis. Movable finger of chela with 53–56 and fixed finger with 44 marginal teeth. Carapace plainly somewhat longer than broad and bearing a single pair of weakly developed eyes, which are clearly more than their own diameter from the anterior carapacal margin; epistomal process vestigial; chætotaxy 4–6 (22). Apical maxillary setæ 4. Tergites with 13–14 and sternites with 14 or 15 marginal setæ; sternites 6–8 with a submedian pair of discal setæ. Palps of slender granulate type. Trochanter granulate, with one or two small posterior protuberances, 2·1–2·2 times as long as broad; femur granulate, gently clavate, and broadest distally, 3·4–3·6 times as long as broad; tibia smooth, with a slender pedicel which is slightly longer than broad, 2·4–2·5 times as long as broad; chela swollen much more greatly on inner than outer face, much as in *macilentum*, 3·0–3·1 times as long as broad; fingers much longer than hand. Length of female 2·8–3·5 mm.

Microcreagris lauræ, sp. n.

Holotype, ♂ (JC. 42.01001), Berkeley, California, i.1920. Cornell University Collection.

Diagnosis. Marginal teeth of chela not ascertainable from type. Carapace much longer than broad, plainly narrowed; with two pairs of weakly developed eyes, the anterior pair of which is more than half an ocular diameter from the posterior pair and 1·5 diameters from the anterior carapacal margin; no epistomal process; chætotaxy 4–6 (22). Apical maxillary

setæ 4. Tergites with 12 and sternites with 15 or 16 marginal setæ; sternites without definitely differentiated discal setæ. Palps of slender granulate type. Trochanter granulate, with a couple of weak protuberances behind, 2·4 times as long as broad; femur prominently granulate, gently clavate, and broadest distally, 3·8 times as long as broad; tibia granulate, with pedicel which is clearly longer than broad, 2·7 times as long as broad; chela flattened on outer and swollen on inner face, as in *macilentum*, plainly somewhat granulate, 3·6 times as long as broad; fingers much longer than hand. Length of male 1·6 mm.

Remarks. Named for Laura Anne Chamberlin.

Microcreagris duncani, sp. n. (Fig. 3 B.)

Holotype, ♂ (JC. 5.01001); allotype, ♀ (JC. 5.01002); paratypes, 22 ♂ and ♀ (JC. 5.01003–24). Collected by C. D. Duncan and the author, i.1.1923, under stones in damp soil on serpentine outcrop, Jasper Ridge, San Mateo County, California.

Additional Material. 2 ♂ (JC. 56.01001–2), Alhambra Valley, Contra Costa County, California, xii.29 (year unknown). Collections of California Academy of Sciences. 1 ♀ (JC. 46.01001), collected by Dr. F. E. Blaisdell, iv.16.1922, San Antonio Canyon, Alameda County, California.

Diagnosis. Movable finger of chela with 57–64 and fixed finger with 55–63 marginal teeth. Carapace plainly longer than broad, with two pairs of weakly developed eyes, the anterior pair of which is ½ diameter from the posterior pair and 1 diameter from the anterior carapacal margin, which is devoid of an epistomal process; chætotaxy 4–6 (24). Apical maxillary setæ 4. Tergites with 11–12 and sternites with about 16 marginal setæ; sternites without clearly differentiated discal setæ. Palps of slender granulate type. Trochanter almost parallel-sided, with one or two small protuberances behind, 2·4–2·6 times as long as broad; femur granulate, broadest subdistally, 3·7–4·2 times as long as broad; tibia with slender pedicel, which is clearly longer than broad, granulate, 2·8–3·1 times as long as broad; chela slender, somewhat granulate near fingers at least, 3·8–4·2 times as long as broad; fingers much longer than hand. Length 2·2–2·5 mm.

Remarks. Close to *lauræ*, sp. n. The Alameda County specimen has a stouter chela than typical material (3·5 times as long as broad). Named for Carl Dudley Duncan.

Microcreagris lampra, sp. n.

Holotype, ♀ (JC. 398.01001); paratype, ♀ (JC. 398. 01002). Collected ix.27.1924, by Dr. F. Silvestri at Kusang (China ?).

Diagnosis. Movable finger with 81 and fixed finger with 85 marginal teeth. Carapace subquadrate, epistomal process weakly developed; with two pairs of strongly developed eyes, the anterior pair of which is $\frac{1}{3}$ ocular diameters from the posterior pair and 1 diameter from the anterior carapacal margin; chætotaxy 6–8 or 9 (about 30). Apical maxillary setæ 5. Tergites with about 12, sternites with 16 marginal setæ; sternites without discal migrants. Palps of a robust granulate type. Trochanter weakly granulate, distally widened, with a distinct protuberance behind and 1·9–2·1 times as long as broad; femur broadest distally, granulate along its inner face, 3·4–3·6 times as long as broad; tibia weakly granulate, with a stout pedicel which is no longer than broad, 2·3 times as long as broad; chela smooth, equally convex anteriorly and posteriorly, 3·0–3·1 times as long as broad; fingers much longer than hand. Length of ♀ about 5·5 mm.

Remarks. Very closely related to *orientalis*, sp. n. The most striking points of difference are indicated in the key.

Microcreagris orientalis, sp. n.

Holotype, ♀ (JC. 397.01001), coll. ii.22.1925, by Dr. F. Silvestri at Lookay (China ?).

Diagnosis. Movable finger with 80, fixed finger with 87 marginal teeth. Carapace subquadrate, with vestigial epistomal process and two pairs of weakly developed eyes, the anterior pair of which is $\frac{1}{3}$ to $\frac{1}{2}$ ocular diameter from posterior pair and 1·5 diameters from the anterior carapacal margin; chætotaxy 6–8 (28). Apical maxillary setæ 5. Tergites with 12 and sternites with about 15 marginal setæ; sternites without discal migrants. Palps moderately robust and granulate. Trochanter weakly granulate, with protuberances behind, 2·2 to 2·3 times as long as broad; femur moderately granulate, especially anteriorly, broadest distally, 3·6 times as long as broad; tibia with slender pedicel which is clearly longer than broad; weakly granulate, especially along its anterior margin, 2·4 times as long as broad; chela evenly swollen on either face, smooth, 3·3 times as long as broad; fingers much longer than hand. Length of ♀ 4·0 mm.

Remarks. Very close to *lampra*, sp. n. Most important differences are indicated in the key.

Microcreagris sp. uncertain or indeterminable.

Material examined. The following specimens are without question members of the genus, but because of immaturity or mutilation are specifically indeterminable.

2 ⊙ (JC. 44.01001–2), collected in moss, Portland, Oregon, iii.28.1921, by Prof. E. O. Essig. Pertains to the medium-fingered smooth-palped group of species.

2 ♀ (badly crushed) (JC. 55.01001–2), Claremont, California (from Hilton). Pertains to the medium-fingered smooth-palped group of species.

2 ♀ (JC. 8.01001–2) (badly crushed and mutilated), coll. x.4.1908, at Kendric, Idaho. Pertains to the long-fingered granulate-palped group of species. Stanford University Collection.

4 ⊙, JC. 440·02001, 441.01001, 443.02001, and 444.01001). Coll. during June and July of 1928 by Prof. Martha W. Shackleford; one taken in sweeping herbs, one in dead-leaf litter in stand of *Alnus oregona,* two in moss on ground in Douglas fir-forest, Friday Harbour, San Juan Island, Washington State. These specimens quite likely pertain to *cingara,* sp. n.

Genus Halobisium, nov.

Orthotype. *Ideobisium orientale*, Redikorzev.

Diagnosis. Adequately characterized in key. Known from the coast of California; Commander Islands (off coast of Kamchatka) and "Siberia."

Halobisium orientale (Redikorzev). (Fig. 1 P.)

1917. *Ideobisium orientale,* Redikorzev, p. 98, figs. (published 1922).

Material examined. 53 specimens: ♂, ♀, and ⊙ (JC. 1.01001–45 and 2 A to 2 H). All collected under boards, logs, and other "drift" on Salicornia flats, Palo Alto Salt-Marshes (shores of San Francisco Bay), California, in situations where flooding at high-tides occurs. First lot collected by author, fall of 1921. Lot 2 collected by O. Elton Sette in April 1921.

1 ♀ (JC. 185.01001), from under board about five feet above water-level in Salicornia salt-marshes east of Palo Alto, ix.6.1925. A number of additional specimens (JC. 285.01001–5) from the same locality were taken on the under side of large logs in company with isopods, amphipods, and a few marine worms, v.27.1928. 1 ♀ (JC. 324.01001), labelled "Claremont, California," collected by C. F. Baker

(the locality Claremont is certainly an error; the specimen most certainly came from a semi-marine habitat, possibly Laguna Beach). 1 ♂ and 1 ♀ (JC. 431.01001–2), Commander Islands, Siberia; material received from Dr. R. V. Chamberlin. All material at present in author's collection.

Remarks. Redikorzev had four specimens from an unknown locality and one specimen from "Province de l'Oussourie du Sud : lac Reineke."

The determination seems certain. Redikorzev's description and figures are good, and the material from Siberia falls well within the limits of variation found in specimens from San Francisco Bay.

Genus Ideobisium, L. Balzan.

1891. *Ideobisium*, L. Balzan, p. 539.

Genotype. *Ideobisium crassimanum*, L. Balzan.

Diagnosis and Remarks. Adequately characterized in the key. The four widely distributed species known to me may be separated by means of the following key. I have not seen material of the genotype, but there is little doubt but what it and the three others with which it is here associated are congeneric:—

1. Fingers clearly shorter than breadth of hand; hand 1·7 times as long as fingers (femur 2·3 times as long as broad; tibia 1·7 times as long as broad): from Venezuela .... *crassimanum*, Balzan, [p. 37.

   Fingers clearly longer than breadth of hand; hand 1·4 or less times as long as fingers .... 2.

2. Subterminal seta suddenly expanded distally into a broad spatulate tip, which is terminally denticulate (fig. 2 CC): from the Seychelles Islands .... *seychellesensis*, sp. n., [p. 38.

   Subterminal seta acute, with fine marginal denticulations or short branches (fig. 2 BB) .... 3.

3. Fingers 1·1–1·2 times as long as breadth of chela; hand 1·1–1·3 times as long as fingers; posterior margin of carapace with six setæ; length 1·5–1·8 mm.: from Lesser Antilles .... *balzanii*, With, p. 37.

   Fingers 1·2–1·3 times as long as breadth of chela; hand 1·0–1·1 times as long as fingers; posterior margin of carapace with 7 or 8 setæ; length 2·2–2·8 mm.: from New Zealand .... *peregrinum*, sp. n., [p. 37.

Ideobisium crassimanum, L. Balzan.

1891. *Ideobisium crassimanum*, L. Balzan, p. 542.

Remarks. I have not seen material of this species.

Ideobisium balzanii, With.

1905. *Ideobisium balzanii*, C. With, p. 131, figs.

Material examined. ♂ (JC. 12.01001), from St. Vincent, Lesser Antilles, West Indies. Exchange from British Museum. This is apparently one of With's paratypes. In poor condition.

Ideobisium peregrinum, sp. n.

Holotype, ♂ (JC. 94.02001), coll. Robert W. Grimmet, xi.20.1920, under log in beech forest, Days Bay, Wellington, New Zealand; allotype, ♀ (JC. 96.01001), coll. in leaf-mould by Robert W. Grimmet near Wellington, New Zealand; paratype, immature ♀ (JC. 460.01001), from Kingston, Lake Watipu, New Zealand, Hogg coll. Property of British Museum of Natural History.

Diagnosis. Fixed finger of chela with 31–35 and movable finger with 37–40 marginal teeth. Carapace about quadrate, slightly longer than broad; very broad rounded epistomal process present; with two pairs of weakly developed eyes, the anterior pair of which is ½ diameter from the posterior pair and over 1 diameter from the anterior carapacal margin; chætotaxy 4–7 or 8 (22–24). Galea stylet-like and gently recurved. Subterminal setæ with many laterally situated short branches, not at all clavate or spatulate. Palps of typical robust form; non-granulate. Trochanter concave behind, 1·6 times as long as broad; femur strongly pedicellate and nearly as strongly swollen anteriorly as posteriorly, broadest slightly proximad of median, 2·5 to 2·7 times as long as broad; tibia stoutly pedicellate and bilaterally expanded, 1·9–2·0 times as long as broad; chela strongly and bilaterally swollen beyond the sharply differentiated pedicel, 2·5 to 2·8 times as long as broad; fingers distinctly shorter than hand. Length of ♂ 2·2, ♀ 2·8 mm.

Remarks. In spite of the great geographical discontinuity of their ranges, this species is remarkably close to *balzanii*, With.

Ideobisium seychellesensis, sp. n.
(Figs. 1 X, DD; fig. 2 CC.)

Holotype, probably ♀ (JC. 510.01001). Coll. by the Seychelles Expedition of 1908, on the 'Felicete.' Only the type known.

Diagnosis. Appearance typical. Fixed finger of chela with 33, movable finger with 40 marginal teeth. Carapace and abdominal structures unknown (the body of the type-specimen having accidentally been lost in course of preparation for study). Spinneret a gently recurved stylet. Subterminal seta distally flaring into a terminally incised spatula (fig. 2 CC). Palps of typical robust non-granulate form. Trochanter concave behind, 1·8 times as long as broad; femur much more swollen posteriorly than anteriorly, broadest proximad of median, 2·6 times as long as broad; tibia strongly pedicellate and bilaterally swollen, 1·9 times as long as broad; chela more strongly swollen on inner than outer face, 2·3 times as long as broad; fingers clearly a little longer than hand. A small species, but, owing to loss of body previously noted, an exact measurement is unavailable.

Family Syarinidæ, nov.

Type. The genus *Syarinus*, J. C. Chamberlin.

Diagnosis and Remarks. Characterized in key. Comprises two distinct subfamilies and three genera, all known thus far only from the western United States. They may be separated by means of the following key:—

Key to Subfamilies and Genera of the Syarinidæ.

1. Subterminal setæ completely simple and acute; femoral articulation of leg iv. plainly oblique (about as in fig. 1 T); galeate spinneret present. (Subfamily SYARININÆ, nov.)	2.
Subterminal setæ plainly toothed or dentate; femoral articulation of leg iv. only weakly oblique (about as in fig. 1 X); galea completely absent. (Subfamily CHITRINÆ, nov.)	*Chitra*, gen. nov.
2. Marginal teeth of movable finger of chela clearly contiguous; T of movable finger present and nearly contiguous with ST; with a single pair of weakly developed eyes or eye-spots	[J. C. Chamberlin. *Syarinus*,
Marginal teeth of movable finger of chela clearly and widely spaced; T of movable finger absent; with 4 distinct eyes......	[J. C. Chamberlin. *Hyarinus*,

Subfamily *Syarininæ*, nov.

Type. The genus *Syarinus*, J. C. Chamberlin.
Diagnosis and Remarks. Characterized in key.

Genus Syarinus, J. C. Chamberlin.

1925. *Syarinus*, J. C. Chamberlin, p. 329.

Orthotype. *Ideoroncus obscurus*, Banks.
Remarks. The genus includes two, and possibly three, species from the western half of the United States.

Syarinus obscurus (Banks).

1893. *Ideoroncus obscurus*, Banks, p. 66.
1925. *Syarinus obscurus* (Banks), J. C. Chamberlin, p. 330.

Material examined. In addition to the material reported by the author in the note cited above, the following material is at hand :—Two specimens (JC. 570.02001–2), sifted from the dead leaves beneath redwoods in Muir Woods, Marin Co., California, coll. by author, ix.7.1927; 3 specimens (JC. 438.01001–3), coll. by A. M. Woodbury, viii.29.1927, in Yellowstone National Park, Wyoming.

Remarks. The male sof this species apparently have a very membranous genital apparatus, and in consequence are very difficult to recognize.

The following couplet will permit its easy separation from *granulatus*, sp. n., its closest relative :—

1. Femur completely smooth and non-granulate; femur 2·6 to 2·8 times as long as broad; chela 2·8–3·0 times as long as broad..............	*obscurus* (Banks).
Femur evenly and distinctly granulate; femur 3·0–3·3 times as long as broad; chela 3·5 times as long as broad.........................	*granulatus*, sp. n.

Syarinus granulatus, sp. n. (Fig. 2 H.)

Holotype, ♂ (JC. 86.01001); allotype, ♀ (JC. 88.01001); paratypes, ♂ (JC. 83.01001) and ♀, 2 (JC. 82.01001–2). All collected by Dr. E. W. Goldsmith in surface-soil or pine-duff beneath Douglas fir-trees, Engleman Canyon, near Alpine Laboratory at Manitou, Colorado.

Diagnosis. Movable finger with 49–50 and fixed finger with 39–44 marginal teeth. Carapace longer than broad, with two weakly developed eyes or eye-spots about an ocular diameter from the anterior carapacal margin; with about 12 marginal setæ along its posterior border as in *obscurus*. Tergites and sternites with 16 and 20 border-setæ respectively, as in *obscurus*. Palps relatively slender, trochanter

and femur finely and evenly granulate. Trochanter scarcely swollen behind, 2·5 times as long as broad; femur pedicellate, evenly rounded behind, slightly and gradually expanded anteriorly, and with a distinct but gentle distal concavity, broadest about medianally, 3·0–3·3 times as long as broad; tibia with stout pedicel, almost bilaterally swollen, as long as carapace and 2·7 times as long as broad; chela strongly pedicellate and somewhat more strongly swollen on its outer than inner face, side of hand nearly parallel, 3·5 times as long as broad; fingers curved and much shorter than the hand, which is itself about the same length as the tibia. Length 2·8–3·0 mm.

Remarks. Very distinct from, although clearly related to, *obscurus*, Banks.

The species described by Banks as *Ideobisium tibiale* from Colorado is almost certainly a member of the present genus. If so, it is probably rather close to the present species.

Genus Hyarinus, J. C. Chamberlin.

1925. *Hyarinus*, J. C. Chamberlin, p. 327.

Orthotype. *Hyarinus hesperus*, J. C. Chamberlin.

Remarks. This genus is known only from the type-species, which has not been taken since its original discovery. The type-locality of the type-species is Santa Barbara, California (see Chamberlin, *l. c.* p. 328).

Subfamily *Chitrinæ*, nov.

Type. The genus *Chitra*, nov.

Diagnosis and Remarks. Characterized in key. Includes only the monotypic type-genus, which is known thus far only from California.

Genus Chitra, nov.

Orthotype. *Chitra cala*, sp. n.

Diagnosis and Remarks. In addition to the characters indicated in the key, the males of this genus possess a peculiar median sensorium (presumably) on the sixth sternite. It consists of a circular membranous area surrounding a median sclerotic patch and bordered by acute setæ.

The genus is known only from the orthotype, which is a rare Californian species.

Chitra cala, sp. n. (Figs. 2 X, JJ.)

Holotype, ♂ (JC. 276.01001), sifted from leaf-mould and grass-roots taken from under a willow-tree on the banks of San Francisquito Creek, Stanford University Campus, California, collected by author xii.17.1927. Paratypes, 1 ♂, 3 ♀ (JC. 42.01001–4), January 1920, Berkeley, California. The holotype and one ♀ paratype are in the author's collection; the balance of the material is in the Cornell University Collection.

Diagnosis. Marginal teeth of fingers of chela well developed anteriorly and posteriorly and on both fingers, 42–50 marginal teeth on fixed and 48–55 on movable finger. Carapace distinctly longer than broad, with two pairs of weakly developed eyes and no epistomal process; chætotaxy 6–8 (28). Tergites and sternites with 18–20 marginal setæ. Palps slender, all segments but trochanter with definite areas of fine but even granulation. Trochanter with small protuberance behind, 2·1 to 2·2 times as long as broad; femur weakly pedicellate, attaining its greatest breadth subbasally, and maintaining it thereafter almost to the tip, sides subparallel, 3·5–3·8 times as long as broad; tibia slenderly pedicellate, pedicel longer than broad, thereafter bilaterally swollen and distinctly narrowed distally, 2·3–2·4 times as long as broad; chela pedicellate, bilaterally expanded, 3·0–3·2 times as long as broad; fingers much longer than hand and also tibia. Length 2·2 to 3·0 mm.

Family **Hyidæ**, nov.

Type. The genus *Hya*, nov.

Diagnosis and Remarks. Characterized in preceding key. Represented by a single rare genus, confined, so far as present knowledge permits us to say, to the Philippine Islands. Most closely related to the Ideoroncidæ.

Genus Hya, nov.

Orthotype. *Hya heterodonta*, sp. n.

Diagnosis and Remarks. In addition to the characters noted in the diagnosis of the family, the following characters are probably of generic extent:—

Heterodentate, marginal teeth of fingers of chela unequally developed. Chelicerae normal, with a simple stylet-like

galea, lamina exterior absent. Eyes four. Femoral articulation of legs iii. and iv. slightly but clearly oblique to the long axis of the compound segment. Femur of legs i. and ii. much longer than patella. Subterminal seta completely simple and unbranched.

Only the orthotype is known.

Hya heterodonta, sp. n. (Fig. 2 KK ; fig. 3 E.)

Holotype, ♂ (JC. 550.04003); allotype, ♀ (JC. 550.04002); paratypes, 7 ♂ and ♀ (JC. 503 A, 550.04001, and 550.04004–8). Mt. Makiling, Luzon, Philippine Islands. C. F. Baker Collection. Four paratypes are deposited in the United States National Museum.

Diagnosis. Chela slender and conspicuously toothed ; fixed finger with 16 acute teeth, which anteriorly are widely spaced ; between the antero-median of these spaced teeth occur from one to three slightly spaced short and rounded smaller teeth (fig. 2 KK) ; movable finger with marginal teeth very weakly developed are nearly absent, apparently of the contiguous type. Carapace slightly broader than long ; without an epistomal process ; with four well-defined eyes, the anterior pair of which is about an ocular diameter from the anterior carapacal margin ; chætotaxy 4–2 (14). Tergites i. and ii. weakly sclerotized, chætotaxy 4 : 4 : 8 : 8 : 8 : 8. Sternites each with about five marginal setæ. Chelicerae with 6 setæ on palm ; galea very slender and needle-like. Palps slender and smooth. Trochanter excavated behind, calyciform, 2·1–2·2 times as long as broad ; femur curved, broadest distad of median, 3·8–4·1 times as long as broad ; tibia stoutly pedicellate, the pedicel shading gradually into the rather slender tibia proper ; tibia equal to or longer than carapace, scarcely broader than femur, and 2·4–2·8 times as long as broad ; chela slightly expanded exteriorly at pedicel, then nearly straight to tip of fingers, interiorly greatly swollen and convex, 3·2–3·3 times as long as broad ; fingers much longer than hand or tibia, and nearly as long as femur. Length 1·2–1·4 mm.

Family Ideoroncidæ, nov.

Type. The genus *Ideoroncus*, L. Balzan.

Diagnosis and Remarks. Characterized in key. Representatives occur in southern Asia, North America, and South America. The five genera and two subfamilies here recognized may be separated by means of the following key :—

Analytical Key to the Subfamilies and Genera of the Ideoroncidæ.

1. Chela with the normal 12 tactile setæ, of which IB is subbasally situated on the dorsum of the hand (empodia distinctly shorter than tarsal claws (as in fig. 2 J)). (Subfamily BOCHICINÆ, nov.)	*Bochica*, gen. nov., [p. 43.
Chela with far in excess of the normal 12 tactile setæ (fig. 3 C) (empodia shorter or longer than tarsal claws). (Subfamily IDEORONCINÆ, nov.)	2.
2. Dorsal quadrangle of tactile setæ of hand of chela large, the distance between the exterior setæ clearly greater than the basal width of the movable finger (the posterior pair of dorsal tactile setæ clearly median): South American genus	*Ideoroncus*, L. Balzan, [p. 44.
Dorsal quadrangle of tactile setæ of chela small and compact, the distance between the two exterior setæ being distinctly less than the basal width of the movable finger: North American or Asiatic forms (if North American, the two basal setæ of the dorsal quadrangle are clearly distad of median on the hand)	3.
3. Empodium clearly longer than and extending far beyond the tarsal claws (fig. 2 P); empodium simple or divided	4.
Empodium clearly shorter than the tarsal claws and always undivided (fig. 2 J) ..	*Dhanus*, gen. nov., [p. 47.
4. Empodia clearly bifurcate (fig. 2 L); tergites and sternites entire; lamina exterior absent	*Albiorix*, gen. nov., [p. 44.
Empodia simple and undivided (fig. 2 Q, R); tergites and sternites clearly divided into two lateral scutæ each; small lamina exterior present......................	*Shravana*, gen. nov., p. 48.

Subfamily *BOCHICINÆ*, nov.

Type. *Bochica*, gen. nov.

Diagnosis and Remarks. Characterized in key. Known from the monotypic type-genus, which is West Indian.

Genus BOCHICA, nov.

Orthotype. *Ideoroncus withi*, J. C. Chamberlin.

Diagnosis and Remarks. Characterized in key. The plainly plicate abdominal pleural membrane associates this rare genus with the Ideoroncidæ rather than the Hyidæ, which it suggests in the normality of the chætotaxy of the chela.

Bochica withi (J. C. Chamberlin).

1905. *Ideoroncus mexicanus*, Banks (misdetermination), C. With, p. 127.
1923 (*b*). *Ideoroncus withi*, J. C. Chamberlin, p. 359 (nom. nov., species described as *Ideoroncus mexicanus*, Banks, by With (*l. c.*)).

Material examined. Through the courtesy of Dr. Susan Finnegan of the British Museum, I have been privileged to examine the specimen upon which With's generally excellent description was based. This specimen, ♀ (JC. 486.01001), has been designated the holotype of the species. It was collected "near Chantilly" (Windward Islands) at 800 feet elevation in fermenting "cocoa-husks."

Subfamily IDEORONCINÆ, nov.

Type. The genus *Ideoroncus*, Balzan.

Diagnosis and Remarks. Characterized, together with its included genera, in the preceding key.

Genus IDEORONCUS, L. Balzan.

1890. *Ideoroncus*, L. Balzan, p. 444.

Genotype. *Ideoroncus pallidus*, L. Balzan.

Remarks. I have been unable to secure material of Balzan's type-species. As a result, the genus must be left inadequately defined. The genus is certainly a valid one, and the only question is as to its relationship to the other genera of the family. In addition to the orthotype it is quite possible that *Ideoroncus gracilis*, Balzan, belongs here.

Ideoroncus pallidus, Balzan.

1890. *Ideoroncus pallidus*, L. Balzan, p. 444, figs.
1910. *Ideoroncus pallidus*, L. Balzan, Ellingsen, p. 395.

Remarks. Balzan's material of this species was from Paraguay. Ellingsen later recorded it from near Rio de Janeiro in Brazil.

Genus ALBIORIX, nov.

Orthotype. *Ideoroncus mexicanus*, Banks.

Diagnosis and Remarks. Adequately characterized in the preceding key. It may be noted that the chela is always considerably broader than deep. The three species of the genus here recognized may be separated by means of the following key:—

1. Margin of fixed finger of chela conspicuously serrate, due to the close-set retro-conical teeth (fig. 2 DD); the movable finger is similarly dentate near its tip .... 2.

   Marginal teeth of both fixed and movable fingers largely obsolete, these teeth being extremely broad at the base, with the very low tooth-cap or apex almost vertically above their respective posterior limits (figs. 2 Y, AA); superficially "toothless," except for the venedens .... *edentatus*, sp. n., p. 46.

2. Fixed finger with a total of 30–32 teeth, of which the posterior ones are low and indistinct, being evident only by the spaced projecting tooth-caps (fig. 2 AA); movable finger with 6–8 rather rounded teeth anteriorly, the balance being vestigial; femur and carapace subequal in length: small species, 1·7–2·0 mm. long.. *parvidentatus*, sp. n., [p. 45.

   Fixed finger with a total of 48–50 teeth, of which the posteriormost are reduced, but not so conspicuously so as in *parvidentatus*; movable finger with 14–20 pretty well marked acute teeth near tip of finger: larger species, 2·3–2·6 mm. long . *mexicanus* (Banks), [p. 45.

Albiorix mexicanus (Banks). (Figs. 2 F, DD.)

1898. *Ideoroncus mexicanus*, Banks, p. 289.
1923 (*b*). *Ideoroncus mexicanus*, Banks, J. C. Chamberlin, p. 359, figs.

Neotype, ♀ (JC. 370.01001), Las Animas Bay, Lower California, Mexico. The original holotype was destroyed in the San Francisco earthquake of 1906, and hence the foregoing designation, which was made in 1923 by the author. Banks's material was from San Miguel de Horcasitas, Sonora, Mexico.

Material examined. Mexico: Gulf of California; San Esteban Island, ♀ (JC. 110.01001). San Marcos Island, ♀ (JC. 371.01001). California: ♀ (JC. 375.02001), El Centro, coll. xii.12.1927, by Dr. F. R. Blaisdell Utah: ♀ (JC. 245.01001), St. George, coll. iii.19.1924 by Dr. V. M. Tanner. 8 ♂ and ♀ (JC. 449.01001-8, "Straight Wash," coll. iv.20.1928, by "W. J. G." ♂ (JC. 450.01001), Straight Canyon, San Rafael Desert, iv.20.1928, coll. by A. M. Woodbury. ♀ (JC. 437.01001), Bluff, coll. iv.16.1928, by "W. J. G." Last three collections received from Dr. R. V. Chamberlin.

Remarks. The Utah specimens seem to be quite typical.

Albiorix parvidentatus, sp. n.

Holotype, ♂ (JC. 535.02001), Palm Canyon, Riverside

County, California. Coll. by the author under a stone on a desert hillside, iv.5.1925.

Other Material examined. A dead and immature female (JC. 547.01003), together with its cast skin, was taken in a silken moulting-capsule from the underside of a stone on a desert hillside near Riverside, California. Coll. xi.26.1925 by the author.

Diagnosis. Fingers of chela with conspicuous retro-conical teeth anteriorly on both fixed and movable fingers; 30–32 in all on fixed finger, becoming progressively reduced and inconspicuous basally; movable finger with six or seven distal teeth, which are clearly defined but scarcely acute; posterior to these the teeth are very much reduced or wholly absent. Carapace typical, about same length as, or shorter than, the femur or the fingers of the palps. Palps slender, all segments more or less evenly granulate. Trochanter with distinct protuberance behind, as in *mexicanus*, 2·2–2·3 times as long as broad; femur of typical form, 4·0–4·2 times as long as broad; tibia normal, very slightly broader than femur and about 3·1 times as long as broad; chela typical in general appearance, 3·8 times as long as broad; fingers much (1·7 times) longer than hand, and about the same length as the carapace and femur; hand 1·2 times as broad as deep. Length of male 1·7–1·8 mm. A very active and graceful species.

Albiorix edentatus, sp. n. (Figs. 2 Y, AA; fig. 1 C.)

Holotype, ♂ (JC. 266.01003); paratypes, 4 immature females (probably) (JC. 266.01001–2 and 4). Collected singly under large boulders on yellow pine-covered hillside, Santa Isabella Creek, east slope of Mt. Hamilton, California. Coll. by author v.18.1924.

Diagnosis. Chela typical, marginal teeth of fingers much reduced and inconspicuous throughout, but, as usual, somewhat more prominent on the fixed than the movable finger; teeth contiguous, but very broad and strongly retro-cuneate, so that the tooth-caps themselves appear as a widely spaced linear series of minute tubercles along the dental margin of the finger (fig. 2 AA); fixed finger with a total of 30–33 marginal teeth; movable finger with about 27, which are only slightly less developed than those of the fixed finger (fig. 2 Y), unlike the case in *mexicanus* or *parvidentatus*. Carapace normal and about the same length or shorter than the femur. Palp slender and typical in appearance, more or less clearly granulate on all its segments, but less

conspicuously so than in *parvidentatus*. Trochanter 2·1–2·3 times as long as broad; femur about as long as or shorter (latter in young specimens) than fingers of chela, about same length as carapace, 4·1 times as long as broad; tibia 3·0–3·2 times as long as broad; chela 3·6 times as long as broad; fingers very much longer than hand, subequal to femur and carapace; hand 1·15–1·20 times as broad as deep. Length of male 2·4 mm.

Remarks. This beautiful and agile form is most nearly related to *parvidentatus*, from which it differs in the dentition of the chela and larger size.

Genus Dhanus, nov.

Orthotype. *Ideoroncus sumatranus*, Redikorzev.

Diagnosis and Remarks. In addition to the characters noted in the key, it may be observed that a small lamina exterior may be present or absent.

The two included species are both south Oriental. They may be separated by means of the following couplet:—

1. Marginal teeth of movable finger weakly developed or obsolete except for the first six or seven; marginal teeth of fixed finger moderately developed throughout; lamina exterior completely absent: small, non-cave-dwelling species, about 2·0 mm. long .... *siamensis* (With), [p. 47.

   Marginal teeth of movable finger strongly developed throughout, as well developed as on the fixed finger; small lamina exterior present: large cave-inhabiting species, about 3·5 mm. long .... *sumatranus* [(Redikorzev), p. 47.

Dhanus siamensis (With).

1906. *Ideoroncus siamensis*, With, p. 81, figs.

Remarks. Through the courtesy of Dr. Kai L. Henriksen I have been privileged to examine one of With's original specimens (♂ (JC. 446.01001)), from Klong Salakpet, Siam.

The general form of this species bears a considerable superficial similarity to members of the genus *Albiorix*.

Dhanus sumatranus (Redikorzev). (Fig. 2 FF; fig. 3 C.)

1922. *Ideoroncus sumatranus*, Redikorzev, p. 545, figs.

Material examined. Two ♂ and three ♀ (JC. 103.01001–5), labelled "Batu caves; in the permanently dark places in the caves." Coll. E. Mjöberg.

Redikorzev's type-material came from "Sumatra, Datu Caves, lower cave, dark, 25.i.1913."

As to whether the two foregoing localities are the same I am unable to ascertain. I had presumed that Mjöberg's material was from Borneo. In response to a direct query concerning this point Mjöberg stated that "all specimens are from Northern Sarawak."

Remarks. My material agrees very well with Redikorzev's excellent description. His figure of the chela, however, is erroneous in that it omits the venom-duct of the movable finger.

Genus SHRAVANA, nov.

Orthotype. *Ideoroncus laminatus*, With.

Diagnosis and Remarks. Adequately characterized in key. The longitudinal division of the tergites and sternites is unique in the Neobisioidea. The genotype and only known species is from Siam.

Shravana laminata (With).

1906. *Ideoroncus laminatus*, With, p. 84, figs.

Material examined. Through the kindness of Dr. Kai L. Henriksen I have been privileged to examine one of With's original specimens, ♀ (JC. 445.01001), from Koh Chang, Siam.

[To be continued.]

II.—*On a new Galago from South-east Africa, with a Note on* Otolicnus garnettii, *Ogilby*. By ERNST SCHWARZ.

IN revising the series of Galagos in the British Museum, the following new race has been found to need description. I have much pleasure in naming it after Professor Einar Lönnberg, the distinguished head of the Naturhistoriska Riksmuseum, Stockholm :—

Galago crassicaudatus lönnbergi, subsp. n.*.

Type-locality. Tambarara, Gorongoza Mts., Portuguese East Africa.

Type. ♂, B.M. no. 8. 1. 1. 17. Collected by Major C. H. B. Grant, 23rd April, 1907 (Rudd Coll.).

* *Galago crassicaudatus*, Thomas and Wroughton, P. Z. S. 1908, p. 166.

Specimens examined. Thirteen, from the type-locality, from Vumba, Gorongoza Mts., and from Melsetter, Rhodesia.

Closely related to *G. c. crassicaudatus* as defined by Thomas*, but darker and with the tail washed with cinnamon-buff.

Upperside grey washed with buffy brown. Colour of arms always distinctly set off from the body-colour, cinnamon-buff; that of the thighs creamy buff. Finger and toes, not the metacarpus, coffee-brown. Lower surface always slightly washed with buffy. Tail always lighter at the tip, distinctly washed with cinnamon-buff. Face very pale, no distinct nasal stripe, but all the hairs in front of the frontal crest fairly pale and generally contrasted with the colour of the crown.

Dimensions of type:—Head and body 287 mm.; tail 371; hind foot 92; ear 57.

Skull: basal length 55. This is a subadult specimen with the basal suture not entirely ankylosed. In a specimen from Vumba (B.M. no. 20. 9. 1. 1, ♂ old) I have taken the following measurements:—Basal length 61·6 mm., upper length 77·1; zygomatic width 51·4; length of upper tooth-row ($C–M^3$) 27·7; premolar–molar series ($P^2–M^3$) 22·2.

This local race of Galago is most nearly related to *crassicaudatus*, but is more tinged with brownish or yellowish both above and below, and especially on the tail, has a pale face without distinct markings, and the fingers and toes dark. It is intermediate between *crassicaudatus* and *umbrosus*, to which the Vumba skins have originally been assigned at the British Museum, but differs clearly from the latter, which has a much darker colour above and a greyish tinge below, dark brown hands and feet, and a dark or blackish tail-tip.

The type-specimen of *Otolicnus garnettii*, Ogilby, which Thomas believed to belong to one of the northern races, is a full-grown specimen which lived at the Zoological Gardens, London, for several years. The very small size of its skull, which induced Thomas to deny its southern origin, is, however, probably due to confinement—in fact, the presence of a parietal plate instead of a sagittal crest, the thickness of the bone, the incomplete ossification of the nasals, are exactly the changes one would expect in an animal with ostitis fibrosa, and which frequently interfere with the process of growth itself.

As regards the skin of the specimen (B.M. no. 55. 12. 24. 50),

* Ann. & Mag. Nat. Hist. (8) xx. p. 49 (1917).

which is in a good condition, only that the tail-tip is missing, it agrees in every detail except size with a specimen from the Cape (B.M. no. 49. 30. 10) and fairly closely with two specimens (B.M. no. 4. 12. 3. 6–7) from the Ngoye Hills, Zululand. It is a brownish, not a buffy and grey animal, its fur is thick and abundant, and, above all, the supraorbital marks are large, as in all the southern animals like *umbrosus* and *lönnbergi*, and not reduced as in the Kenya (*G. c. lasiotis*, Peters) and Zanzibar (*G. c. agisymbanus*, Coquerel) animals. To conclude, the specific name *garnettii*, Ogilby, will have to stand as the subspecific name for the Cape race of *G. crassicaudatus*, with *zuluensis*, Elliot, as a synonym.

III.—*New Genera and Species of* Phycitinæ (*Lepidoptera*, Pyralidæ). By Sir George F. Hampson, Bart.

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Genus Africella, nov.

Type, *A. micræola*.

Palpi upturned, slender, the second joint reaching to about middle of frons, the third moderate; frons smooth; eyes large, round; antennæ of male somewhat laminate and and minutely ciliated. Fore wing narrow; vein 2 from near angle of cell; 3 and 5 separate, 4 absent; 6 from upper angle; 9 absent; 10–11 from cell. Hind wing with vein 2 from just before angle of cell; 3 and 5 on a long stalk, 4 absent; the discocellulars oblique and not angled; 6–7 shortly stalked; 8 anastomosing with 7 to near apex.

Africella micræola, sp. n.

♂. Head, thorax, and abdomen reddish brown mixed with grey-white; antennæ fuscous, ringed with white except towards tips; anal tuft white tinged with ochreous. Fore wing grey-white irrorated with fuscous-brown, the costa and terminal area more suffused with fuscous-brown; the antemedial line represented by a small black-brown spot on vein 1; a dark shade from costa to median nervure; two distinct black discoidal points; subterminal line grey-white, almost straight; cilia with a fine dark line near base. Hind wing semihyaline white tinged with brown, the veins and termen browner; cilia with a brown line near base.

Gold Coast, Bibianaha (*Spurrell*), ♂ type. *Exp.* 10 mm.

Africella amydra, sp. n.

♀. Head, thorax, and abdomen dark reddish brown mixed with grey; the antennæ blackish, the palpi, pectus, legs, and ventral surface of abdomen whitish mixed with red-brown, the tarsi black-brown ringed with white. Fore wing grey-white suffused and irrorated with dark reddish brown; the first line medial, whitish defined on outer side by blackish, oblique, sinuous; two distinct black discoidal points; subterminal line whitish defined on inner side by blackish, sinuous. Hind wing semihyaline whitish tinged with red-brown especially on the veins and towards termen; a blackish terminal line; cilia white tinged with red-brown except at base and tips.

Br. E. Africa, Escarpment (*Doherty*), 1 ♀ type. *Exp.* 16 mm.

Genus Taprobania, nov.

Type, *T. glaucochroa*.

Proboscis fully developed, palpi upturned, smoothly scaled, the second joint reaching to just above vertex of head, the third rather long; maxillary palpi filiform; frons smooth, with ridge of scales above; eyes large, round; antennæ of female often simple; tibiæ smoothly scaled. Fore wing narrow, the apex rounded, the termen obliquely curved; veins 2–3 from near angle of cell, downcurved; 4–5 from angle; 6 from below upper angle; 9 absent; 10–11 from cell. Hind wing with the cell about one-third length of wing; vein 2 from angle; 3 and 5 strongly stalked, 4 absent, the discocellulars oblique, not angled; 6–7 stalked; 8 anastomosing with 7 to about three-fourths of wing.

Taprobania glaucochroa.

†*Homœsoma glaucochroa*, Hmpsn. Journ. Bomb. Nat. Hist. Soc. xviii. p. 260 (1908).

Ceylon.

Genus Rhynchephestia, nov.

Type, *R. rhabdotis*.

Proboscis fully developed; palpi downcurved, extending about twice the length of head and moderately scaled below to end of second joint; maxillary palpi slightly dilated with scales; frons smooth; eyes large, round; antennæ of male laminate and thickened towards base, almost simple; tibiæ smoothly scaled. Fore wing narrow, the apex rounded, the termen obliquely curved; vein 2 from close to angle of cell;

3 and 5 separate, 4 on a very long stalk with 5 or absent; 6 from upper angle; 9 absent; 10–11 from cell. Hind wing with vein 2 from well before angle of cell; 3 and 5 separate, 4 absent; the discocellulars inwardly oblique, not angled; 6–7 from upper angle of cell; 8 anastomosing with 7 to three-fourths of wing.

Rhynchephestia rhabdotis, sp. n.

♂. Head and thorax black-brown with a leaden gloss, the vertex of head at sides, genæ, and a ring round neck fulvous, the palpi white to towards extremity of second joint where the white ends obliquely, the antennæ black-brown; abdomen black-brown; pectus, legs, and ventral surface of of abdomen white tinged with brown, the legs with some blackish. Fore wing glossy black-brown; the costal area irrorated with white to beyond middle; a rather diffused white fascia from base through the cell to just beyond it with some white irroration below it and beyond it where it extends to just below the costa. Hind wing dark brown; cilia brownish white with a dark line near base. Underside of fore wing with the inner area whitish; hind wing white tinged with brown.

HAWAII, Maui (*Terry*), 2 ♂ type. *Exp.* 20 mm.

Larva on *Argyroxiphium*.

Genus NEONONIA, nov.

Type, *N. taprobalis*.

Proboscis fully developed; palpi upturned to about vertex of head and smoothly scaled, the third joint as long as the second; maxillary palpi filiform; frons smooth; eyes large, rounded; antennæ of male almost simple; tibiæ smoothly scaled. Fore wing narrow, the apex rounded, the termen evenly curved; vein 2 from well before angle of cell; 3 and 5 shortly stalked, 4 absent; 6 from below upper angle; 9 absent; 10–11 from cell. Hind wing with vein 2 from well before angle of cell; 3 and 5 strongly stalked, 4 absent; the discocellulars erect and slightly angled, 6–9 shortly stalked; 8 anastomosing with 7 to three-fourths of wing.

Neononia taprobalis.

Nonia taprobalis, Hmpsn. Journ. Bomb. Nat. Hist. Soc. xviii. p. 259 (1907).

CEYLON.

Genus Unadillides, nov.

Type, *U. distichella.*

Proboscis fully developed; palpi obliquely upturned, extending to about the vertex of head and moderately fringed with scales below; maxillary palpi slightly dilated with scales at extremity; frons smooth; eyes large, round; antennæ of male somewhat annulate and almost simple; tibiæ smoothly scaled. Fore wing narrow, the apex rounded, the termen obliquely curved; vein 2 from towards angle of cell; 3 and 5 separate, 4 absent; 6 from upper angle; 9 absent; 10–11 from cell. Hind wing with vein 2 from near angle of cell; 3 and 5 strongly stalked, 4 absent; the discocellulars angled; 6–7 stalked; 8 anastomosing with 7 to near apex.

Unadillides distichella.

Homœosoma distichella, Meyr. Pr. Linn. Soc. N.S.W. iii. p. 215 (1878); Rag. Rom. Mém. viii. p. 262, pl. 39. f. 20.

Queensland; N.S. Wales; Victoria.

Unadillides microphæa, sp. n.

Head and thorax dark red-brown mixed with some whitish; abdomen whitish suffused with red-brown; tarsi dark brown ringed with white. Fore wing dark red-brown irrorated with whitish, the terminal area rather darker; a whitish medial line, excurved in submedian interspace; a whitish subterminal line incurved below costa and at submedian fold; cilia with a white line at base. Hind wing ochreous-white tinged with red-brown especially towards termen, the veins red-brown; cilia with an ochreous-white line at base.

Sierra Leone (*Clements*), 2 ♂ type. *Exp.* 10–12 mm.

Genus Nasutes, nov.

Type, *N. venata.*

Proboscis fully developed; palpi downcurved, about three times length of head and moderately scaled below; maxillary palpi filiform; frons smooth; eyes large, round; antennæ of male ciliated; tibiæ smoothly scaled. Fore wing narrow, the apex rounded, the termen obliquely curved; vein 2 from long before angle of cell; 3 and 5 separate, 4 absent; 6 from upper angle; 9 absent; 10–11 from cell. Hind wing with vein 2 from near angle of cell; 3 and 5 strongly stalked, 4 absent; the discocellulars strongly angled; 6–7 stalked; 8 anastomosing with 7 to near apex.

Nasutes venata, sp. n.

♂. Head and thorax whitish tinged with brownish ochreous, the shoulders and outer part of patagia fuscous, pencilled with white, the antennæ blackish below, the palpi fuscous pencilled with white; abdomen white suffused with fuscous leaving white segmental lines, the anal tuft ochreous-white; pectus, legs, and ventral surface of abdomen white mixed with fuscous. Fore wing brownish ochreous, the costal area white irrorated with black, the veins white defined by black formed by streaks of black scales; cilia white mixed with fuscous. Hind wing white strongly tinged with fuscous-brown, the cilia whiter.

U.S.A., Colorado, Boulder (*Cockerell*), 1 ♂ type. *Exp.* 20 mm.

Genus Chrysoscinia, nov.

Type, *C. plicata.*

Proboscis fully developed; palpi upturned, the second joint reaching to about vertex of head and moderately scaled, the third nearly as long as the second and with triangular tuft of scales in front; frons smooth, with tuft of scales above; eyes large, round; antennæ of male somewhat laminate and almost simple; the vertex of head tufted with scales; tibiæ smoothly scaled; abdomen of male long and with lateral tufts of scales on medial segments. Fore wing narrow, the costa moderately arched, the apex rounded, the termen evenly curved; vein 2 from long before angle of cell, curved; 3 from well before angle; 4–5 from angle, in line with the median nervure; 6 from upper angle; 8, 9, 10 stalked; 11 from cell. Hind wing with the cell about one-third length of wing; vein 2 from just before angle of cell; 3 and 5 stalked, 4 absent; the discocellulars angled; 6–7 shortly stalked; 8 anastomosing with 7; the male with a strong fold thickened by a ridge of scales just below the cell extending to about three-fourths of wing.

Chrysoscinia plicata, sp. n.

Head and thorax pale rufous, the frons and ridge of scales above it black in male, the antennæ fuscous, the palpi with the third joint black; abdomen golden orange, the basal segment pale rufous; pectus and legs pale reddish brown, the tibiæ and tarsi banded with fuscous. Fore wing flesh-colour suffused with dark purple-brown; short oblique blackish streaks from base of costa and median nervure; antemedial line almost medial, rather diffused blackish with

some silvery-white scales on its outer edge, strongly angled outwards below costa at median nervure and above inner margin; subterminal line white defined on inner side by blackish brown, slightly excurved at middle; an orange line at base of cilia. Hind wing orange, strongly suffused with brown except on inner area and cilia.

Br. N. Guinea, Milne Bay (*Meek*), 1 ♂, 1 ♀ type. *Exp.* 16 mm.

C ✓ Genus Mesciniella, nov.

Type, *M. micans.*

Proboscis fully developed; palpi upturned, the second joint reaching to vertex of head, in male rather broadly scaled in front, in female moderately scaled, the third in male short and thickly scaled, in female as long as the second joint and smoothly scaled; maxillary palpi filiform; frons rather hollowed out in centre in male, smooth in female; eyes large, round; antennæ of male somewhat laminate and almost simple; fore and mid tibiæ smoothly scaled, the hind tibiæ with tuft of hair above at extremity. Fore wing narrow, the costa rather strongly arched towards apex which is rounded, the termen evenly curved; veins 2 and 3 stalked from well before angle of cell, curved; 4–5 from angle; 6 from upper angle; 8 and 10 stalked, 9 absent; 11 from cell. Hind wing with the cell about one-third length of wing; vein 2 from well before angle of cell; 3 and 5 stalked, 4 absent; the discocellulars curved; 6–7 shortly stalked; 8 anastomosing with 7 to near apex; the male with a large lobe at base of costa, its extremity tufted with hair, a fringe of hair beyond it for a short distance just below the costa.

Mesciniella micans.

Euzophera micans, Hmpsn. Moths Ind. iv. p. 74 (1896); id. Rom. Mém. viii. p. 86, pl. 48. f. 3.

Ceylon.

c ✓ Genus Caustella, nov.

Type, *C. micralis.*

Proboscis fully developed; palpi upturned, the second joint reaching to about middle of frons and moderately scaled in front, the third moderate and thickly scaled except at tips; maxillary palpi filiform; frons smooth, without tuft of scales; eyes large, round; antennæ of male minutely ciliated; mid and hind tibiæ moderately fringed with hair. Fore wing rather narrow, the apex rounded, the termen evenly

curved; vein 2 from well before angle of cell, 3 from angle; 4–5 shortly stalked; 6 from upper angle; 8–9 stalked; 10–11 from cell. Hind wing with the cell about half the length of wing; vein 2 from well before angle of cell; 3 and 5 on a long stalk, 4 absent; the discocellulars straight and erect; 6–7 from upper angle; 8 anastomosing with 7 to near apex.

Caustella micralis.

Heterographis micralis, Hmpsn. Moths Ind. iv. p. 70 (1896); id. Rom. Mém. viii. p. 28, pl. 48. f. 19.

TRANSVAAL; NATAL, Durban in coll. Janse; CEYLON.

Caustella phœnicias, sp. n.

Head and thorax black glossed with leaden grey usually with more or less purplish red near extremity of the patagia; abdomen grey tinged with fuscous and with some ochreous at extremity; pectus and legs grey suffused with black, the tarsi ringed with white. Fore wing with the basal half purple-red, the costa suffused with black and irrorated with silvery-grey scales; an ill-defined ochreous band tinged with red just beyond middle, narrowing to costa; the rest of wing black irrorated with silvery-grey and with a narrow purple-red subterminal band not reaching the costa. Hind wing grey tinged with fuscous; a dark terminal line and whitish line at base of cilia.

TRANSVAAL, Pretoria (*Janse*), 1 ♂, 3 ♀ type. *Exp.* 12–14 mm.

Caustella strigifera, sp. n.

Euzophera cinerosella, Hmpsn. Mon. Christmas I. p. 73 (nec Zell).

Head, thorax, and abdomen white mixed with red-brown. Fore wing white suffused with red-brown and slightly irrorated with blackish, the costal area whiter to near apex where it tapers to a point; a black streak below basal part of costa and slight streak below the cell near base; a medial black point on median nervure; an obscure white discoidal bar defined by black scales and with black streaks just before and beyond it on the veins to near termen, interrupted except towards costa by the indistinct whitish subterminal line which is oblique below vein 4; a terminal series of black points. Hind wing whitish suffused with red-brown, the cilia whiter.

CHRISTMAS I. (*Andrewes*), 1 ♂, 1 ♀ type. *Exp.* 18 mm.

Genus Mascelia, nov.

Type, *M. ectophæa*.

Proboscis fully developed; palpi upturned, the second joint reaching to about middle of frons and rather broadly scaled in front, the third long and thickly scaled to near tip; maxillary palpi dilated with scales; frons smooth; eyes large, round; antennæ of male strongly laminate and almost simple; fore and mid tibiæ smoothly scaled, the hind tibiæ with tuft of hair above at extremity; abdomen with lateral tufts of scales. Fore wing narrow, the apex rounded, the termen evenly curved; vein 2 from towards angle of cell, curved; 3 from just before angle; 4–5 from angle, not in line with the median nervure; 6 from angle; 8, 9, 10 stalked; 11 from cell. Hind wing with the cell about half the length of wing; vein 2 from well before angle of cell; 3 and 5 from angle, 4 absent; the discocellulars curved; 6–7 shortly stalked; 8 anastomosing with 7.

Mascelia ectophæa.

Euzophera ectophæa, Hmpsn. Journ. Bomb. Nat. Hist. Soc. xviii. p. 262, pl. E. f. 19 (1908).

Ceylon.

Genus Phestinia, nov.

Type, *P. costella*.

Proboscis fully developed; palpi upturned, moderately scaled, the second joint reaching to about vertex of head, the third long; maxillary palpi dilated with scales and flattened against the frons which is smooth and with a tuft of hair above; eyes large, round; antennæ of male with slight tufts of scales at the joints; tibiæ slightly fringed with hair. Fore wing narrow, the apex rounded, the termen evenly curved; vein 2 from just before angle of cell, oblique; 3 and 5 stalked, 4 absent; 6 from upper angle; 8–9 stalked; 10–11 from cell. Hind wing with the cell about one-third length of wing; vein 2 from middle of cell; 3 and 5 from angle, 4 absent; the discocellulars oblique; 6–7 stalked; 8 anastomosing with 7 almost to apex.

Phestinia costella, sp. n.

♂. Head red-brown; thorax and abdomen red-brown mixed with white; pectus, legs, and ventral surface of abdomen white mixed with some red-brown, the tarsi red-brown ringed with white. Fore wing whitish suffused with red-brown, the costal area nearly pure white with the costal

edge brown towards base, the terminal area slightly suffused with red-brown and with dark streaks below veins 6, 5, 3; the first line almost medial, oblique to median nervure where it is angled outwards, then inwardly oblique; two blackish discoidal points; subterminal line indistinct, whitish defined on inner side by brown, oblique; a slight dark terminal line. Hind wing white suffused with reddish brown, the cilia nearly pure white.

JAMAICA, Constant Springs (*Walsingham*), 1 ♂ type. *Exp.* 20 mm.

Genus SYMPHESTIA, nov.

Type, *S. ephestialis.*

Proboscis fully developed; palpi upturned, moderately scaled, the second joint reaching to about middle of frons, the third moderate; maxillary palpi minute and slightly dilated with scales; frons smooth; eyes large, round; antennæ of female somewhat laminate and almost simple; tibiæ smoothly scaled. Fore wing rather narrow, the apex rounded, the termen evenly curved; vein 2 from well before angle of cell, oblique; 3 and 5 from angle, 4 absent; 6 from upper angle; 8, 9, 10 stalked; 11 from cell. Hind wing with the cell about half the length of wing; vein 2 from well before angle of cell; 3 and 5 stalked, 4 absent; the discocellulars oblique; 6–7 shortly stalked; 8 strongly anastomosing with 7.

Symphestia ephestialis.

Euzophera ephestialis, Hmpsn. Journ. Bomb. Nat. Hist. Soc. xv. p. 24 (1903).

SIKHIM.

Genus JACUTSCIA, nov.

Type, *J. strigata.*

Proboscis fully developed; palpi downcurved, extending about twice the length of the head and thickly scaled; maxillary palpi of male brush-like in a fold of the labial palpi; frons with slight conical prominence with raised edges; eyes large, round; antennæ of male with the basal joint long, the shaft laminate and almost simple, with a sinus at base containing slight scale-like teeth; tibiæ smoothly scaled. Fore wing rather narrow, the costa evenly arched, the apex rounded, the termen obliquely curved; vein 2 from towards angle of cell, curved; 3 from angle; 4 absent; 5 not in line

with the median nervure; 6 from upper angle; 8, 9, 10 stalked; 11 from cell. Hind wing with the cell about half the length of wing; vein 2 from angle of cell; 3 and 5 strongly stalked, 4 absent; the discocellulars obliquely curved; 6–7 stalked; 8 anastomosing with 7.

Jacutscia strigata, sp. n.

♂. Head, thorax, and abdomen ochreous-white mixed with some pale red-brown; pectus, legs, and ventral surface of abdomen ochreous-white irrorated with brown. Fore wing ochreous-white with diffused streaks of dark brown irroration along the veins. Hind wing grey-brown, the cilia whitish with a brown line near base. Underside grey-brown.

N. SIBERIA, Schigansk, 1 ♂ type. *Exp.* 30 mm.

Genus ETHIOPSELLA, nov.

Type, *E. nasuta.*

Proboscis fully developed; palpi downcurved, extending about three times length of head, the second joint thickly scaled above; maxillary palpi slightly dilated with scales; frons smooth; eyes large, round; antennæ of female almost simple, the basal joint rather long; tibiæ smoothly scaled. Fore wing narrow, the apex rounded, the termen obliquely curved; vein 2 from well before angle of cell, oblique; 3 and 5 from angle, 4 absent; 6 from upper angle; 8, 9, 10 stalked; 11 from cell. Hind wing with the cell about half the length of wing; vein 2 from just before angle of cell; 3 and 5 on a long stalk, 4 absent; the discocellulars curved; 6–7 from upper angle; 8 anastomosing with 7 to about three-fourths of wing.

Ethiopsella nasuta, sp. n.

♀. Head and thorax grey-brown mixed with some pale reddish; abdomen grey-brown; pectus, legs, and ventral surface of abdomen dark brown mixed with whitish, the tarsi black-brown ringed with white. Fore wing grey-brown mixed with some pale reddish and with obscure dark streaks on the veins; an indistinct dark antemedial line from cell to inner margin, small discoidal spot, and oblique postmedial line slightly incurved at submedian fold. Hind wing semi-hyaline white, the costa slightly tinged with brown; a fine brown terminal line and line near base of cilia.

S. NIGERIA, Baro (*Simpson*), 1 ♀ type. *Exp.* 20 mm.

Genus Ogilvia, nov.

Type, *O. pulverealis.*

Proboscis fully developed; palpi downcurved, extending about three times length of head and thickly scaled; maxillary palpi dilated with scales and appressed to the frons which is rounded and with a tuft of scales; eyes large, round; antennæ of male somewhat laminate and almost simple; fore and mid tibiæ smoothly scaled, the hind tibiæ with slight tufts of hair above at base and extremity. Fore wing rather narrow, the apex rounded, the termen evenly curved; vein 2 from well before angle of cell, oblique; 3 from just before angle; 4–5 from angle, not in line with the median nervure and approximated for some distance; 6 from upper angle, 8–9 stalked; 10–11 from cell. Hind wing with the cell about half the length of wing; vein 2 from near angle of cell which is produced; 3 and 5 from angle and approximated for some distance, 4 absent; the discocellulars curved; 6–7 from upper angle; 8 not anastomosing with 7.

Ogilvia pulverealis.

Hypogryphia pulverealis, Hmpsn. Bull. Liverp. Mus. ii. p. 39 (1899); id. Nat. Hist. Sokotra, p. 333, pl. xx. f. 16.

Sokotra.

Genus Œdothmia, nov.

Type, *Œ. endopyrella.*

Proboscis fully developed; palpi upturned, the second joint reaching to well above vertex of head and moderately scaled, the third moderate and thickly scaled; maxillary palpi triangularly scaled and flattened against the frons, which has a thickly scaled pointed conical prominence; eyes large, round; antennæ of male somewhat laminated and almost simple, the basal joint rather large, the shaft very slightly excised at base; tibiæ smoothly scaled. Fore wing narrow, the apex rounded, the termen obliquely curved; vein 2 from just before angle of cell, curved and closely approximated to 3; 3 and 5 from angle, 4 absent; 6 from upper angle; 8–9 stalked; 10–11 from cell. Hind wing with the cell about half the length of wing, its lower extremity produced; vein 2 from just before angle of cell; 3 and 5 strongly stalked; the discocellulars very oblique; 6–7 shortly stalked; 8 anastomosing with 7 to about three-fourths of wing.

Œdothmia endopyrella, sp. n.

Eurythmia ignidorsella, Druce, Biol. Centr.-Am., Het. ii. p. 565 (part.), nec Rag.

♂. Head, tegulæ, and patagia whitish tinged with pale red, the outer edge of patagia and dorsum of thorax black, the antennæ blackish above, the palpi pale red, whitish in front, the third joint blackish; abdomen brownish white with some black at base; pectus and legs pale red mixed with some white. Fore wing black-brown; a white costal fascia irrorated with pale red, narrowing to a point at apex: a few silvery scales above medial part of vein 1 and near end of cell; two pale fulvous-red spots on inner medial area, conjoined below vein 1. Hind wing white with some brown suffusion on terminal area except towards tornus and a dark terminal line; cilia white with a brownish line near base.

MEXICO, Vera Cruz, Atoyac (*Schumann*), 1 ♂ type Godman-Salvin Coll. *Exp.* 18 mm.

Genus SYNOTHMIA, nov.

Type, *S. bahamasella*.

Proboscis fully developed; palpi upturned, the second joint reaching to well above vertex of head and moderately scaled, the third moderate and thickly scaled; maxillary palpi of female filiform; frons smooth; eyes large, round; antennæ of female almost simple, the basal joint rather long, the shaft very slightly excised at base; tibiæ smoothly scaled. Fore wing narrow, the apex rounded, the termen obliquely curved; vein 2 from close to angle of cell, curved; 3 and 5 from angle, 4 absent; 6 from upper angle; 8–9 stalked; 10–11 from cell. Hind wing with the cell about half the length of wing, its lower extremity strongly produced; vein 2 from just before angle of cell; 3 and 5 strongly stalked, 4 absent; the discocellulars strongly angled; 6–7 from upper angle; 8 anastomosing with 7 to about three-fourths of wing.

Synothmia bahamasella, sp. n.

♀. Head and thorax dark reddish brown mixed with some grey-white, the antennæ blackish, the palpi whitish to middle of second joint, then blackish; abdomen reddish brown, obscurely banded with grey-white, the anal tuft ochreous; pectus, legs, and ventral surface of the abdomen dark brown mixed with grey-white. Fore wing black-brown with a few

silvery-white scales, the costal area white irrorated with pale red, extending in end of cell to discal fold, then narrowing to apex, a small red spot on it at upper angle of cell; some pale red on basal inner area and a patch on medial area from submedian fold to inner margin, its outer edge oblique, the antemedial line represented by the dark area between these two patches and a small white spot on vein 1; a minute white spot at lower angle of cell; an oblique silvery-white subterminal line. Hind wing white tinged with brown especially on terminal area; a dark terminal line; cilia whitish with a brown line through them.

BAHAMAS, Nassau (*Sir G. Carter*), 1 ♀ type. *Exp.* 16 mm.

Genus CAYENNIA, nov.

Type, *C. rufitinctalis*.

Proboscis fully developed; palpi upturned, the second joint reaching to about middle of frons and slenderly scaled in front, the third moderate; maxillary palpi filiform; frons smooth; eyes large, round; antennæ of male somewhat laminate and minutely ciliated; tibiæ slightly fringed with hair. Fore wing rather narrow, the costa arched towards apex which is rounded, the termen obliquely curved; vein 2 from towards angle of cell, curved; 3 from before angle; 4–5 stalked, not in line with the median nervure; 6 from below upper angle; 8, 9, 10 stalked; 11 from cell. Hind wing with the cell about half the length of wing; vein 2 from just before angle of cell; 3 and 5 strongly stalked, 4 absent; 6–7 stalked; 8 anastomosing with 7 to near apex.

Cayennia rufitinctalis, sp. n.

♂. Head and thorax grey mixed with brown; abdomen grey suffused with fuscous-brown. Fore wing grey, irrorated with fuscous, the basal half of inner area and the tornal half of terminal area tinged with rufous; medial line whitish defined on each side slightly by rufous and with minute black streaks before and beyond it on the veins; black points at angles of cell and others on bases of veins 2–3; postmedial line very indistinct; pale, defined by black marks before and beyond it on costa and minute black streaks before it on the veins; a terminal series of black points. Hind wing semihyaline whitish tinged with brown, especially on the veins and terminal area.

FR. GUIANA, Cayenne (*Schaus*), 1 ♂ type. *Exp.* 18 mm.

Genus Penetiana, nov.

Type, *P. proleucia.*

Proboscis fully developed; palpi upturned to just above vertex of head, smoothly scaled, the third joint moderate; maxillary palpi filiform; frons smooth; eyes large, round; antennæ of male somewhat laminate and almost simple; tibiæ smoothly scaled. Fore wing narrow, the apex rounded, the termen obliquely curved; vein 2 from well before end of cell, oblique; 3 and 5 from angle, 4 absent; 6 from upper angle; 8–9 stalked; 10–11 from cell, 10 closely approximated to 8–9. Hind wing with the cell about half the length of wing, its lower angle produced; vein 2 from angle; 3 and 5 strongly stalked, 4 absent; the discocellulars angled; 6–7 stalked; 8 anastomosing with 7 to towards apex.

Sect. I.—Antennæ of male with the shaft excised towards base and with slight scale-teeth in the excision.

Penetiana penthetria, sp. n.

♂. Head, thorax, and abdomen black with a leaden gloss; tarsi ringed with white; ventral surface of abdomen black irrorated with white, the sides and terminal segments white tinged with brown. Fore wing black-brown glossed with leaden grey; antemedial line silvery grey, oblique; a slight white discoidal bar; subterminal line silvery grey, slightly incurved below costa. Hind wing semihyaline white, the costal area suffused with fuscous; a fine black terminal line except towards tornus. Underside of fore wing whitish suffused with fuscous except on inner area.

Port. E. Africa, M. Chiperone (*Neave*), 1 ♂ type. *Exp.* 26 mm.

Sect. II.—Antennæ of male without sinus at base of shaft.

Penetiana proleucia, sp. n.

Head and thorax pale brown mixed with whitish; abdomen white tinged with ochreous-brown, the ventral surface brown. Fore wing whitish suffused and irrorated with brown, the costal area white except towards base, ill-defined below; subterminal line indistinct, whitish defined on inner side by brown, somewhat angled outwards below costa, then oblique; a dark terminal line and fine white line at base of cilia. Hind wing white slightly tinged with brown; a fine brown terminal line.

S.E. Borneo (*Doherty*), 1 ♂ type; Philippines, Luzon, Mt. Makiling (*Baker*), 1 ♀. *Exp.* 16 mm.

Genus AUCHMERA, nov.

Type, *A. falsalis*.

Proboscis fully developed; palpi obliquely upturned, moderately scaled, the second joint reaching to about vertex of head, the third short; maxillary palpi filiform; frons smooth; eyes large, round; antennæ of male with the basal joint long and thickly scaled, the shaft with sinus at base, strongly ciliated; tibiæ smoothly scaled, the mid-tibiæ of male dilated with a fold containing a tuft of hair. Fore wing narrow, the apex rounded, the termen evenly curved; vein 2 from near angle of cell, curved; 3 from angle; 4–5 strongly stalked in line with the median nervure; 6 from upper angle; 8–9 stalked; 10–11 from cell. Hind wing with the cell about half the length of wing; vein 2 from angle of cell; 3 and 5 strongly stalked, 4 absent; the discocellulars obliquely curved; 6–7 stalked; 8 not anastomosing with 7.

Auchmera falsalis.

Heterographis falsalis, Hmpsn. Journ. Bomb. Nat. Hist. Soc. xviii. p. 261 (1908).

MADRAS, Gooty.

Auchmera yezonis, sp. n.

♂. Head, thorax, and abdomen pale red-brown; pectus and legs red-brown mixed with some white. Fore wing greyish suffused with red-brown; antemedial line indistinct, sinuous, pale with tufts of raised blackish scales on its outer side in and below the cell; slight dark medial marks on median nervure and at inner margin; an indistinct oblique diffused brown postmedial line. Hind wing white suffused with red-brown; a dark terminal line and fine white line at base of cilia.

JAPAN, Yezo, Hakodaté (*Andrews*), 1 ♂ type. *Exp.* 24 mm.

Auchmera melanodes, sp. n.

♀. Head and thorax black-brown suffused with grey-white; abdomen fuscous with brownish-white segmental bands; pectus and ventral surface of abdomen brownish white; legs black-brown irrorated with white, the tarsi ringed with white. Fore wing black-brown irrorated with grey-white; a grey-white antemedial band traversed by a black line which is rather oblique to median nervure; a faint blackish discoidal spot; subterminal line indistinct,

grey-white, excurved at middle. Hind wing whitish suffused with brown, especially on the veins, costal and terminal area; a dark terminal line; cilia white with a dark line near base.

W. AUSTRALIA, Waroona (*Berthoud*), 1 ♀ type. *Exp.* 18 mm.

Auchmera homographis, sp. n.

♀. Head, thorax, and abdomen whitish tinged with reddish brown, the antennæ fuscous ringed with whitish; pectus and legs white mixed with some brown, the tarsi ringed with brown; ventral surface of abdomen ochreous-white. Fore wing grey-white mixed with pale reddish brown and some blackish; antemedial line whitish with slight blackish points on its outer side at the veins and a patch of blackish irroration before it at inner margin, oblique, sinuous; subterminal line whitish defined on inner side by blackish, very slightly excurved at middle; some blackish scales on termen and a brown line through the cilia; hind wing semihyaline white tinged with brown; a dark terminal line, cilia white.

ALGERIA, Batna (*Eaton*), 1 ♀ type. *Exp.* 20 mm.

Genus TRICHORACHIA, nov.

Type, *T. leonina*.

Proboscis fully developed; palpi upturned, the second joint reaching to vertex of head and rather broadly scaled in front, the third rather long and thickly scaled; maxillary palpi slightly dilated with scales; frons smooth; eyes large, round; antennæ of male somewhat laminate and minutely ciliated; tibiæ slightly fringed with hair. Fore wing rather narrow, the costa slightly arched, the apex rounded, the termen obliquely curved; vein 2 from well before angle of cell, oblique; 3 from before angle; 4–5 stalked, not in line with the median nervure; 6 from upper angle; 8–9 stalked; 10–11 from cell; the male on underside with oblique ridge of long upturned hair from origin of vein 8 to vein 6 before termen. Hind wing with the cell about one-third length of wing; vein 2 from just before angle of cell; 3 and 5 strongly stalked, 4 absent; 6–7 stalked; 8 not anastomosing with 7.

Trichorachia leonina, sp. n.

♂. Head and thorax red-brown mixed with some whitish; abdomen whitish suffused with rufous. Fore wing red-brown irrorated with whitish; an obliquely curved whitish

antemedial line; an oblique whitish subterminial line; a dark terminal line and white line at base of cilia. Hind wing semihyaline white, the costal and terminal areas slightly tinged with ochreous.

SIERRA LEONE (*Clements*), 4 ♂; S. RHODESIA, Umvuma (*Janse*), 1 ♂.

Genus HARRARIA, nov.

Type, *H. rufipicta*.

Proboscis fully developed; palpi with the second joint obliquely porrect, extending about twice the length of head, the third short, downturned; maxillary palpi of male brush-like, in a fold of the labial palpi; frons with horizontally flattened corneous plate covered by a tuft of hair; eyes large, round; antennæ of male minutely ciliated with a slight sinus at base of shaft containing minute scale-teeth; tibiæ smoothly scaled; abdomen with slight crests on two basal segments. Fore wing narrow, the apex rounded, the termen obliquely curved; vein 2 from towards angle of cell, curved; 3 from just before angle; 4–5 from angle, in line with the median nervure; 6 from upper angle; 8–9 stalked; 10–11 from cell. Hind wing with the cell about half the length of wing; vein 2 from angle of cell; 3 and 5 strongly stalked, 4 absent; the discocellulars obliquely curved; 6–7 stalked; 8 not anastomosing with 7.

Harraria rufipicta, sp. n.

♂. Head and thorax greyish suffused with rufous, the antennæ brown, greyish above, the palpi brownish grey, the third joint darker brown; abdomen greyish tinged with fulvous; pectus, legs, and ventral surface of abdomen brownish white. Fore wings brownish grey, the submedian interspace suffused with rufous to the antemedial line which is whitish, oblique, and slightly sinuous, a patch of rufous and black scales on its inner side at inner margin, and blackish points on its outer side below costa and at median nervure and vein 1; a small rufous discoidal spot with some blackish scales on it, crossed by a rufous streak from before end of cell to the subterminal line, which is whitish defined on inner side by black-brown, oblique towards costa and slightly angled inwards at discal and submedian folds; the terminal area suffused with rufous and with some black-brown scales towards termen; cilia tinged with rufous.

Hind wing semihyaline whitish tinged with rufous; a brown terminal line; cilia whitish with a brown line near base.

ABYSSINIA, Harrar (*Degen*), 1 ♂ type. *Exp.* 22 mm.

Genus HOMŒOGRAPTA, nov.

Type, *H. spectrifasciella.*

Proboscis fully developed; palpi of male upturned, with the second joint reaching to rather above vertex of head, moderately scaled in front and hollowed out to receive the brush-like maxillary palpi, the third short and thickly scaled; frons with large thickly scaled conical prominence; eyes large, round; antennæ of male almost simple; tibiæ smoothly scaled. Fore wing narrow, the apex rounded, the termen obliquely curved; veins 2 and 3 curved, from close to angle of cell; 4–5 from angle; 6 from upper angle; 8–9 stalked; 10–11 from cell. Hind wing with the cell about half the length of wing; vein 2 from angle of cell; 3 and 5 on a long stalk, 4 absent; the discocellulars obliquely curved; 6–7 shortly stalked; 8 closely approximated to 7 to about three-fourths length of wing.

Homœograpta spectrifasciella.

Staudingeria spectrifasciella, Rag. Ann. Soc. Ent. Fr. 1887, p. 250; id. Rom. Mém. viii. p. 140, pl. 28. f. 14; Staud. Cat. Lep. pal. ii. p. 21.

W. TURKESTAN.

Genus ŒDILEPIA, nov.

Type, *Œ. striginervella.*

Proboscis fully developed; palpi upturned, the second joint reaching to about vertex of head, moderately scaled, in male typically hollowed out to receive the large brush-like maxillary palpi, the third short, thickly scaled; frons smooth, with large tuft of scales above; eyes large, round; antennæ of male typically with short branches on outer side towards base, then serrate to about two-thirds length, ciliated on inner side, a small scale-tooth on shaft above towards base, the basal joint long; the metathorax with paired tufts of scales at sides; hind tibiæ with slight tufts of hair above at base and extremity; abdomen with minute flattened dorsal crest at base. Fore wing narrow, the apex rounded, the termen evenly curved; vein 2 from towards angle of cell, curved; 3 from just before angle; 4–5 closely approximated for some distance, not in line with the median

nervure; 6 from upper angle; 8–9 stalked; 10–11 from cell; the upper side with oblique antemedial and erect medial series of bosses of raised scales except towards costa. Hind wing with the cell about half the length of wing; its lower extremity produced; vein 2 from before angle of cell; 3 approximated for some distance to 4–5 which are strongly stalked; the discocellulars obliquely curved; 6–7 shortly stalked; 8 not anastomosing with 7.

Sect. I.—Palpi of male with the second joint hollowed out to receive the brush-like maxillary palpi; antennæ with short branches on outer side towards base, then serrate to two-thirds length, ciliated on inner side, a small scale-tooth on shaft above towards base.

Œdilepia striginervella.

Nephopteryx striginervella, Hmpsn. J. Bomb. Nat. Hist. Soc. xv. p. 28 (1903).

Ceylon.

Sect. II.—Maxillary palpi of male filiform, the palpi with large tuft of scales on second joint at extremity behind; antennæ somewhat laminate and almost simple, a sinus at base of shaft containing a double ridge of scales; hind wing on underside with slight streaks of androconia on subcostal and median nervures to end of cell.

Œdilepia stictoglaucella, sp. n.

♀. Head and thorax white slightly mixed with brown, the palpi with the second and third joints blackish at base; abdomen white with brownish bands; tarsi black-brown ringed with white. Fore wing white irrorated with dark brown, obliquely-placed antemedial bosses of raised blackish scales in lower part of cell and above and below vein 1; a white medial line, strongly excurved below costa, then oblique, bosses of raised black scales before it in lower part of cell and above vein 1; a blackish discoidal bar with grey striga in centre, a boss of raised white and dark scales before it, and another in submedian interspace; subterminal line white, interrupted and with short black streaks before and beyond it, strongly bent inwards below costa and with longer streaks before and beyond it, then oblique to vein 5, then dentate, strongly bent inwards in submedian interspace and acutely angled outwards above inner margin, a black mark beyond it on costa; a terminal series of small black spots; cilia white tinged with brown. Hind wing semi-hyaline white, the veins, costal area, and termen tinged with

brown; a dark terminal line and brown line near base of cilia.

NATAL, Umkomaas, in Coll. Janse; CAPE COLONY, Annshaw (*Miss F. Barrett*), 3 ♀ type. *Exp.* 24–26 mm.

Genus ASEMEIA, nov.

Type, *A. aprepia.*

Proboscis fully developed; palpi with the second joint obliquely upturned to about vertex of head, rather curved forward at extremity and moderately scaled, the third porrect, short and thickly scaled; maxillary palpi filiform; frons smooth; eyes large, round; antennæ of female somewhat laminate and almost simple; tibiæ smoothly scaled. Fore wing narrow, the apex rounded, the termen evenly curved; vein 2 from towards angle of cell, curved; 3 from just before angle; 4–5 from a point, in line with the median nervure; 6 from upper angle; 8, 9, 10 stalked; 11 from cell. Hing wing with the cell about one-third length of wing; vein 2 from angle of cell; 3 strongly stalked with 4–5; the discocellulars oblique; 6–7 strongly stalked; 8 anastomosing with 7.

Asemeia aprepia, sp. n.

♀. Head and thorax pale ochreous-brown; abdomen fulvous-yellow, the basal segment pale ochreous-brown; pectus and legs white mixed with pale ochreous-brown. Fore wing pale ochreous-brown mixed with whitish and without markings, except a slightly darker discoidal striga. Hind wing whitish suffused with pale ochreous-brown.

CEYLON, Puttalam (*Pole*), 1 ♀ type. *Exp.* 16 mm.

Genus HOMODIGMA, nov.

Type, *H. geera.*

Proboscis fully developed; palpi upturned, smoothly scaled, the second joint reaching to vertex of head, the third moderate; maxillary palpi triangularly dilated with scales; frons smooth, with a tuft of scales; eyes large, round; antennæ of female somewhat laminate and almost simple; hind tibiæ with a tuft of long hair above from base and fringe of hair towards extremity. Fore wing narrow, the apex rounded, the termen evenly curved; vein 2 from well before angle of cell, oblique; 3 from just before angle; 4–5 from a point, not in line with the median nervure;

6 from upper angle; 10 strongly stalked with 8–9; 11 from cell. Hind wing with the cell about one-third length of wing; vein 2 from angle of cell; 3 strongly stalked with 4–5; the discocellulars oblique; 6–7 stalked; 8 not anastomosing with 7.

Homodigma geera, sp. n.

♀. Head and thorax red-brown, the frons and palpi whitish suffused with red-brown, the latter with faint red-brown rings near extremity of second joint and at middle of third; abdomen whitish suffused with red-brown; pectus and legs grey mixed with red-brown, the hind tibiæ with a black band towards extremity. Fore wing red-brown mixed with grey; medial line represented by an oblique blackish striga from costa, points on subcostal and median nervures, and a whitish mark in submedian interspace; subterminal line whitish defined on inner side by dark scales, bent outwards below discal fold, then oblique; a black terminal line except towards apex and tornus, and ochreous line at base of cilia. Hind wing semihyaline whitish tinged with red-brown; a darker terminal line and white line at base of cilia, followed by a brown line.

Ceylon (*Alston*) 1 ♀, Peradeniya 1 ♀ type. *Exp.* 20–24 mm.

Genus Procunea, nov.

Type, *P. siderea*.

Proboscis fully developed; palpi upturned, the second joint reaching to vertex of head, the first and second joints very broadly scaled in front, the third short and thickly scaled; maxillary palpi long and broadly dilated with scales, porrect and lying between the labial palpi; frons with very large tuft of scales above, flattened below and rounded above; eyes large, round; antennæ of male somewhat laminate and almost simple, a large double ridge of scales at base of shaft but no sinus, the basal joint dilated; the vertex of head hollowed out and with a large fan of scales behind; a tuft of hair below base of fore wing, fore femora with large tuft of hair above, the hind tibiæ with tufts of hair above at base and extremity; abdomen with flattened crests on two basal segments, the second segment rather hollowed out subdorsally. Fore wing narrow, the costa arched, the apex rounded, the termen evenly curved; the cell narrow and the median nervure slightly curved upwards; vein 2 from near angle of cell, curved; 3 from angle; 4–5 almost from a point; 6 from upper angle; 8–9 stalked; 10–11 from cell.

Hind wing with the cell about one-third length of wing; vein 2 from angle of cell; 3 strongly stalked with 4–5; the discocellulars obliquely curved; 6–7 stalked; 8 not anastomosing with 7; the male with the costa strongly arched, with an elongate patch of rough scales below its basal half on upper side, and vein 8 rather sinuous and not approximated to the cell, and vein 7 from near base to about three-fourths of wing.

Procunea siderea, sp. n.

♂. Head, thorax, and abdomen grey tinged with iron-brown; pectus, legs, and ventral surface of abdomen whitish slightly tinged with brown. Fore wing grey, the costal half irrorated with dark brown, the inner half suffused with iron-brown; a medial black point on vein 1; an obliquely curved postmedial series of short black streaks on veins 6 to 1; a terminal series of black points in the interspaces between veins 8 and 2, with a few black scales beyond them on the cilia. Hind wing semihyaline white, the inner one tinged with ochreous; a fine brown terminal line and line near base of cilia.

QUEENSLAND, Townsville (*Dodd*), 1 ♂ type. *Exp.* 28 mm.

Genus PSAMMIA, nov.

Type, *P. flavipicta*.

Proboscis rather small and slender; palpi downcurved, extending about two and a half times length of head and moderately scaled; maxillary palpi filiform; frons with large rounded prominence with corneous plate below it; eyes large, round; antennæ of male with long cilia; tibiæ smoothly scaled. Fore wing long and narrow, the apex rounded, the termen evenly curved; vein 3 from towards angle of cell, curved; 3 from before angle; 4–5 from a point, not in line with the median nervure; 6 from upper angle; 8–9 stalked; 10–11 from cell. Hind wing with the cell about one-third length of wing; vein 2 from angle of cell; 3 strongly stalked with 4–5; the discocellulars angled; 6–7 shortly stalked; 8 not anastomosing with 7.

Psammia flavipicta, sp. n.

♂. Head and thorax ochreous-white with a few brown scales, the antennæ brownish, the frons with black points at sides; abdomen, pectus, and legs ochreous-white, the tarsi

ringed with brown. Fore wing ochreous-white irrorated with black; antemedial line black defined on inner side by white and with a fulvous-yellow band before it below discal fold, oblique, waved, a diffused fulvous-yellow fascia beyond it in submedian interspace, and a small discoidal annulus; postmedial line formed by diffused black scales with an ill-defined white band on its outer side, very oblique from costa towards apex to lower angle of cell, then strongly angled outwards and again oblique to inner margin; a diffused black terminal line. Hind wing creamy white with a slight blackish terminal line except towards tornus.

U.S.A., Florida, 1 ♂ type. *Exp.* 24 mm.

Genus Melanastia, nov.

Type, *M. bicolor.*

Proboscis rather slender; palpi downcurved, in male extending about twice the length of head, the second joint hollowed out to receive the brush-like maxillary palpi and with tuft of scales above at extremity, the third moderate and thickly scaled, in female extending about three times length of head and smoothly scaled; frons smooth; eyes large, round; antennæ of male with the basal joint long and somewhat dilated, the shaft minutely serrate with a large sinus at base containing a double ridge of scales; tibiæ smoothly scaled. Fore wing narrow, the costa arched, the apex rounded, the termen evenly curved; vein 2 from well before angle of cell, oblique; 3 from near angle; 4–5 approximated for some distance, not in line with the median nervure; 6 from upper angle; 8–9 stalked; 10–11 from cell. Hind wing with the cell about half the length of wing; vein 2 from well before angle of cell; 3 approximated for a short distance to 4–5 which are strongly stalked; the discocellulars curved; 6–7 strongly stalked; 8 not anastomosing with 7.

Melanastia bicolor, sp. n.

Head, thorax, and abdomen glossy black-brown; tarsi ringed with white. Fore wing uniform glossy black-brown irrorated with a few white scales especially on inner area. Hind wing semihyaline white faintly tinged with brown; a brown terminal line and line near base of cilia.

S. Nigeria, Yorubaland, Ogbomosa (*Sir G. Carter*), 1 ♂, 1 ♀ type; Mashonaland, Salisbury (*Marshall*), 1 ♂. *Exp.* 20–24 mm.

Genus Veldticola, nov.

Type, *V. striatella.*

Proboscis fully developed; palpi thickly scaled, the second joint upturned to about vertex of head and with slight tuft of scales behind at extremity, the third moderate, porrect; maxillary palpi somewhat dilated with scales; frons smooth; eyes large, round; antennæ of male somewhat laminate and almost simple, the basal joint long, the shaft with a sinus at base containing a double ridge of scales; hind tibiæ with slight tufts of hair above at base and extremity; abdomen with small flattened dorsal crests on the two basal segments. Fore wing narrow, the apex rounded, the termen evenly curved; vein 2 from well before angle of cell, oblique; 3 from near angle; 4–5 from angle, approximated for some distance and almost in line with the median nervure; 6 from upper angle; 8–9 stalked; 10–11 from cell. Hind wing with the cell about half the length of wing; vein 2 from well before angle of cell; 3 from angle, approximated for some distance to 4–5 which are strongly stalked; the discocellulars curved; 6–7 shortly stalked; 8 anastomosing with 7. The male on underside with some black androconia on costal area of both wings to beyond middle.

Veldticola persinuella, sp. n.

♀. Head and thorax grey-white tinged with brown, the palpi whitish with an oblique brown band towards extremity of second joint; abdomen dark brown suffused with grey; pectus and ventral surface of abdomen whitish tinged with rufous, the legs whitish tinged with grey-brown. Fore wing pale brownish grey, the costal area, the area beyond the cell, and the terminal area whiter; a dark brown antemedial mark on costa and oblique black striga from costa; a black point in middle of cell with black streak beyond it in discal fold, with white spots above and below it; the veins on costal area towards apex white defined on outer side by slight black streaks; the postmedial area with black streaks on veins 4 to 1 and on inner margin, and short streaks on veins 7 to 5 before the subterminal line which is black defined on outer side by white, strongly excurved between veins 5 and 2, then strongly angled inwards at submedian fold and outwards at vein 1; a black terminal line; cilia with fine white lines near base and tips. Hind wing semi-hyaline white with a faint brown tinge; a brown terminal line; cilia white with a brown line near base.

Transvaal, White R. (*Cooke*), 1 ♀ type. *Exp.* 26 mill.

Veldticola striatella, sp. n.

Head and thorax purplish grey, the head with some black scales, the tegulæ, patagia, and dorsum of thorax with black streaks, the antennæ black, the palpi blackish, whitish above; abdomen rufous with the basal crests grey; pectus, legs, and ventral surface of abdomen white and blackish. Fore wing purplish grey, the veins streaked with black to the subterminal line and black streaks in discal and submedian folds to end of cell, a white streak above median nervure; antemedial line represented by a white line to median nervure angled outwards below costa and a diffused black mark defined on inner side by white above inner margin; subterminal line white defined on each side by black, slightly excurved from vein 7 to submedian fold; a black terminal line and fine yellowish line at base of cilia. Hind wing semihyaline white with a faint brownish tinge; a brown terminal line; cilia pure white with a fine yellowish line at base followed by a brown line.

The male on underside with black androconia on costal area of both wings to beyond middle.

Transvaal (*Pead*) 1 ♂ type, Pretoria (*Janse*) 1 ♀. *Exp.* 24 mm.

Veldticola nebulosella, sp. n.

♀. Head and thorax grey-white, the tegulæ with some black scales, the patagia with black streaks, the antennæ black, the palpi white and black with a black patch near extremity of second joint; abdomen pale rufous with some dark scales, the crests on basal segment grey; pectus and legs black mixed with white, the tarsi tinged with white. Fore wing grey-white thickly irrorated and clouded with dark brown; an antemedial black shade with black streaks on it at subcostal and median nervures and a diffused black patch at inner margin; a slight white streak above median nervure except towards base; black spots defined by white except on inner side at extremities of subcostal and median nervures and a black spot with white before and beyond it at middle of vein 1; subterminal line white defined on each side by diffused black, rather indistinct, excurved from vein 7 to submedian fold; a terminal series of ill-defined black points; cilia with a fine black line near tips. Hind wing semihyaline white, the costal area tinged with brown; a brown terminal line and line near base of cilia.

Transvaal, Pretoria (*Janse*), 1 ♀ type. *Exp.* 26 mm.

Veldticola irrorella, sp. n.

♀. Head, thorax, and abdomen pale rufous irrorated with black, the antennæ pale red-brown; pectus and ventral surface of abdomen white tinged with rufous. Fore wing pale rufous thickly irrorated with black; traces of a pale antemedial line, slightly excurved between discal and submedian folds; a terminal series of prominent black points. Hind wing semihyaline white with a faint red-brown tinge; a brown terminal line and line near base of cilia.

TRANSVAAL, White R. (*Cooke*), 1 ♀ type. *Exp.* 28 mm.

Veldticola macra, sp. n.

♀. Head and thorax grey tinged with red-brown and slightly irrorated with black, the antennæ slightly tinged with black, the palpi with the extremity of second joint and the third joint darker; abdomen grey tinged with red-brown; pectus, legs, and ventral surface of abdomen grey tinged with red-brown and irrorated with black. Fore wing grey rather sparsely irrorated with black, the cell and area just beyond it whiter, the inner and terminal areas tinged with red-brown; antemedial line double, blackish filled in with whitish, rather oblique to submedian fold and angled inwards at vein 1; a black discoidal bar; subterminal line double, blackish filled in with whitish, oblique to discal fold and excurved at middle and vein 1; a rather punctiform black terminal line from just below apex to vein 2, and a whitish line at base of cilia. Hind wing whitish tinged with red-brown, a dark terminal line and line near base of cilia.

BR. E. AFRICA, Kinjabe (*Betton*), 1 ♀ type. *Exp.* 32 mm.

Veldticola megista, sp. n.

Head and thorax fuscous-brown mixed with pale bluish grey, the antennæ dark brown, the basal joint above and ridge of scales in male whitish; abdomen whitish and fuscous-brown with pale red-brown segmental bands; pectus, legs, and ventral surface of abdomen fuscous-brown and white, the tarsi blackish tinged with white. Fore wing bluish white tinged with brown and irrorated with black. Antemedial line rather diffused black-brown defined on inner side by white, oblique, angled outwards at discal and submedian folds and inwards at vein 1; two large black-brown discoidal points; subterminal line white defined on inner side by black-brown and less distinctly on outer, oblique to discal fold where it is angled inwards, angled outwards at middle,

then oblique and dentate; a terminal series of black points. Hind wing semihyaline white, the veins of terminal half tinged with brown, the apical area suffused with brown; a blackish terminal line; cilia with a fuscous line near base and tinged with fuscous at tips.

MASHONALAND, Umtali (*Janse*), 1 ♂, 2 ♀ type. *Exp.* 34–42 mm.

Genus EMMERITA, nov.

Type, *E. mirandella.*

Proboscis fully developed; palpi upturned, broadly scaled, the second joint reaching to about middle of frons, the third short; maxillary palpi dilated with scales, in male the palpi hollowed out to receive the large brush-like maxillary palpi; frons smooth; eyes large, round; antennæ of male somewhat laminate and almost simple, the shaft with sinus at base containing a double ridge of scales; hind tibiæ with small tufts of hair above at base and extremity; abdomen with small flattened dorsal crests on two basal segments. Fore wing rather narrow, the costa arched, the apex rounded, the termen evenly curved; vein 2 from well before angle of cell, oblique; 3 from just before angle; 4–5 approximated for some distance, not in line with the median nervure; 6 from upper angle; 8, 9, 10 stalked; 11 from cell. Hind wing with the cell about half the length of wing, the lower angle produced; vein 2 from near angle of cell; 3 approximated for some distance to 4–5 which are strongly stalked; the discocellulars curved; 6–7 shortly stalked; 8 not anastomosing with 7.

Emmerita mirandella.

Meroptera mirandella, Rag. Rom. Mém. vii. p. 313, pl. 47. f. 4 (1893); Dyar, Cat. Lep. N. Am. p. 423.

U.S.A., Colorado.

Genus STYPHLORACHIS, nov.

Type, *S. mesophæa.*

Proboscis fully developed; palpi upturned, the second joint hardly reaching to vertex of head and rather broadly scaled in front, the third rather long and thickly scaled; maxillary palpi filiform; frons smooth; eyes large, round; antennæ somewhat laminate and almost simple; tibiæ smoothly scaled. Fore wing rather narrow, the apex

rounded, the termen evenly curved; vein 2 from towards angle of cell, curved, 3 from just before angle; 4–5 from a point; 6 from upper angle; 8–9 stalked; 10–11 from cell; the upper side with an antemedial ridge of raised scales except towards costa. Hind wing with the cell about one-third length of wing; vein 2 from before angle of cell; 3 from angle; 4–5 strongly stalked; the discocellulars curved; 6–7 shortly stalked; 8 anastomosing with 7.

Styphlorachis mesophæa, sp. n.

♀. Head and thorax dark olive-brown mixed with some whitish, the antennæ dark brown, the palpi dark brown mixed with white; abdomen pale olive-brown with whitish segmental lines; pectus and legs white mixed with blackish, the tarsi black ringed with white. Fore wing olive-brown suffused with dark brown; an oblique triangular white patch irrorated with black from costa to inner margin before the broad antemedial ridge of silvery blackish scales which is followed by a conical patch of cupreous-red and olive before the dark antemedial line which is oblique to submedial fold and slightly incurved at vein 1; the medial costal area blackish; an obliquely curved blackish discoidal bar with an oblique triangular white patch thickly irrorated with blackish from postmedial part of costa to its outer side; subterminal line whitish defined on each side by diffused blackish, incurved to vein 5, then very slightly waved and incurved below vein 3; a terminal series of black points and white line at base of cilia. Hind wing white tinged with brown especially on the veins and costal area; a brown terminal line and line near base of cilia.

Br. C. Africa, Lake Nyasa (*de Jersey*), 1 ♀; Transvaal, White R. (*Cooke*) 1 ♀, Barberton (*Janse*) 4 ♀ type. *Exp.* 18 mm.

Genus Myelodes, nov.

Type, *M. jansei*.

Proboscis fully developed; palpi downcurved, extending about twice the length of head and thickly scaled; maxillary palpi dilated with scales at extremity; frons smooth; eyes large, round; antennæ of female laminate and almost simple; hind tibiæ fringed with hair above. Fore wing narrow, the apex rounded, the termen evenly curved; vein 2 from towards angle of cell; 3 from before angle; 4–5 stalked; 6 from

well below upper angle; 8–9 stalked; 10–11 from cell. Hind wing with the cell more than half the length of wing; vein 2 from long before angle of cell; 3 from angle; 4–5 strongly stalked: the discocellular curved; 6–7 from upper angle; 8 not anastomosing with 7.

Sect. I.—Fore wing with veins 4–5 strongly stalked.

Myelodes flavimargo, sp. n.

♀. Head and throat silvery white, the antennæ tinged with fuscous, the palpi orange-yellow; abdomen orange-yellow, the basal segment white; pectus, legs, and ventral surface of abdomen white tinged with yellow, the fore legs streaked with black above, the mid-femora black above at extremity. Fore wing silvery white, the costa, termen, and cilia yellow, the costal edge black towards base; small antemedial black spots on median nervure and vein 1, two discoidal spots and a curved subterminal series; a terminal series of black points except towards apex and tornus. Hind wing pale yellow. Underside of fore wing yellow suffused with black except on inner and terminal areas.

Transvaal, Pretoria (*Janse*), 2 ♀ type; Basutoland, Masite (*Weigall*), 1 ♀. *Exp.* 22 mm.

Sect. II.—Fore wing with veins 4–5 very shortly stalked.

Myelodes jansei, sp. n.

♀. Head white with a black bar above the frons, the antennæ black, barred with white above, the palpi with the second and third joints black above, except at tips, the maxillary palpi black, white at tips; tegulæ golden-yellow, with black spots at base; thorax slate-grey with some black on prothorax; abdomen golden-yellow; pectus yellow, white in front; legs white, the fore legs black above, the mid-femora and base of tibiæ black above, the hind legs black mixed with white, the tibiæ fringed with yellow hair above, the spurs and tarsi black, the latter ringed with white. Fore wing silvery white to median nervure and vein 5, the costal edge black, expanding with a patch at base; the inner half o wing slate-grey, extending on terminal area to near apex; a small black spot below base of cell; antemedial spots in the cell and on median nervure and vein 1, the spot in the cell nearer the base; two discoidal spots, a curved

subterminal series to vein 2 and a slight spot on vein 1, a terminal series. Hind wing golden-yellow; a terminal fuscous line to vein 4. Underside of fore wing fuscous, some white below costa towards base and some yellow in upper part of cell except towards base, a diffused black postmedial spot on costa with some whitish suffusion before and beyond it.

S. Rhodesia, Umtali (*Janse*), 1 ♀ type. *Exp.* 46 mm.

Genus Meyrickialis, nom. nov.

	Type.
Meyrickiella, Hmpsn. Rom. Mém. viii. p. 86 (1901), nec Berg, 1898	*homosema.*

Proboscis fully developed; palpi upturned, the second joint reaching to vertex of head and moderately scaled, the third short and thickly scaled; maxillary palpi filiform; frons rounded and thickly scaled; eyes large, round; antennæ of male somewhat laminate and almost simple, the shaft with a sinus at base containing a large ridge of scales; fore and mid tibiæ smoothly scaled, the hind tibiæ with a small tuft of hair above at extremity. Fore wing narrow, the costa slightly arched, the apex rounded, the termen evenly curved; vein 2 from towards angle of cell, curved; 3 from just before angle; 4–5 strongly stalked; 6 from upper angle; 8–9 stalked; 10–11 from cell. Hind wing with the cell about one-fourth length of wing; vein 2 from well before angle of cell; 3 and 5 from angle, 4 absent; the discocellulars erect; 6–7 stalked; 8 anastomosing with 7.

Meyrickialis homosema.

Hypophana homosema, Meyr. Trans. Ent. Soc. 1887, p. 264; Rag. Rom. Mém. viii. p. 86, pl. 26. f. 15.

W. Australia; N.S. Wales; S. Australia.

Genus Anousterunia, nom. nov.

	Type.
Pogonophorus, Saub. Verh. Ver. Naturw. Unterh. Hamb. x. p. 63 (1899), nec Latr. Coll. 1802	*tancrei.*
Pogonotrophus, Saub. Verh. Ver. Naturw. Unterh. Hamb. x., Corrig. (1899), nec *Pogonatropha*, Zell. Lep. (1852)	*tancrei.*

Proboscis fully developed; palpi porrect, in male extending about one and a half times length of head, in female

about the length of head, almost hidden by long hair; maxillary palpi minute; head hairy, the frons without prominence; eyes rather small in male, small in female, round; antennæ of male typically with fasciculate cilia; tibiæ fringed with hair above. Fore wing narrow, the apex rounded, the termen evenly curved; vein 2 from towards angle of cell; 3, 4, 5 separate; 6 from upper angle; 8–9 stalked; 10–11 from cell. Hind wing with the cell about half the length of wing; vein 2 from well before angle of cell; 3 and 5 from angle, 4 absent; the discocellulars angled; 6–7 from upper angle or shortly stalked; 8 typically anastomosing with 7.

Sect. I.—Antennæ of male with fasciculate cilia; hind wing with veins 6–7 from upper angle of cell, 8 anastomosing with 7.

Anousterunia tancrei.

Pogonophorus tancrei, Sauber, Verh. Ver. Naturw. Unterh. Hamb. x. p. 63 (1899); Staud. Cat. Lep. pal. ii. p. 25.

W. Turkestan.

Sect. II.—Antennæ of male laminate and minutely ciliated; hind wing with veins 6–7 shortly stalked, 8 not anastomosing with 7.

Anousterunia alticola, sp. n.

♂. Head and thorax black-brown with a slight rufous tinge; abdomen black-brown, the anal tuft grey-white; pectus and legs black-brown, the tarsi tinged with grey-white. Fore wing grey-white mixed with very dark red-brown, the discal fold beyond the cell and submedian fold with obscure rufous streaks; antemedial line strong, white defined on outer side by rather diffused black, oblique and slightly excurved; an oblique black discoidal bar; subterminal line white strongly defined on inner side by black, rather oblique and slightly excurved at middle; a terminal series of rather diffused black points; cilia whitish at base, pale red-brown at tips. Hind wing blackish tinged with grey, the costa to near apex and the cilia except at base whiter. Underside greyish suffused with fuscous, the terminal area of fore wing and the apical area of hind wing greyer; fore wing with oblique black postmedial line slightly excurved at middle.

Kashmir, Rupshu, 17,500 feet (*Avinoff*), 1 ♂ type. *Exp.* 20 mm.

IV.—*New* Derbidæ *from Sierra Leone* (Homoptera Fulgoroidea).
By F. Muir.

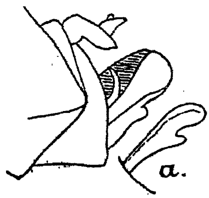
The species mentioned below were submitted to me, along with others, for identification by the Imperial Bureau of Entomology. The types will be placed in the collection of the British Museum (Natural History).

Cedusa nigripes, sp. n. (Fig. 1.)

Male.—Length 1·8 mm.; tegmen 2·5 mm.

Shoulder-keels not very large; subantennal plate longer than wide; length of frons twice the width, no median carina; width of vertex at base twice the length, base wider than apex. *M* with five apical veins, viz., 1, 1 *a*, 2, 3, 4; forking of *Sc*+*R* and *Cu* about level; cross-veins near nodal line, apical cross-veins subparallel to apical margin.

Lateral and ventral margins of pygofer entire, slightly curved; anal segment small, apex rounded; genital styles small, apex round,



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Cedusa nigripes, sp. n.

Lateral view of male genitalia; *a*, ventral view of left genital style.

a curved spine near base on dorsal margin, inner margin produced into a round process about the middle.

Head and thorax stramineous; middle of clypeus and frons fuscous, thorax darker; labium dark fuscous; front legs dark fuscous, hind legs with the femora and first two tarsi stramineous, rest fuscous; abdomen reddish brown. Tegmina hyaline, slightly fuscous or dirty stramineous, veins darker; wings hyaline with brown veins.

Female.—Length 1·8 mm.; tegmen 3 mm.

Similar to the male in build and colour. Pregenital plate angularly produced from sides to middle.

Hab. Sierra Leone, Kailahun, "ex Piasaara" (*E. Hargreaves*, May 1928), described from four males and four females.

Phenice bicornis, sp. n. (Figs. 2, 3.)

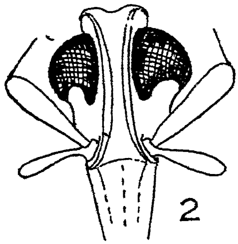
Male.—Length 2·9 mm.; tegmen 5·3 mm.

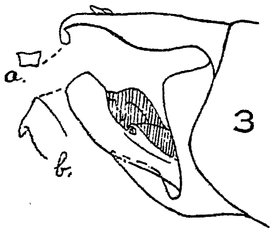
This species differs from all the others of the genus in having the basal segment of the antenna produced into a long, narrow, flattish process. Antennæ about as long as the frons, the process from the basal segment not so long as the second segment. Carinæ

on clypeus obscure. Basal *Ms* furcate at the spot where *M–Cu* cross-vein joins it.

The anal segment truncate at apex, which is curved ventrad; medio-ventral process large, lanceolate; genital styles long, inner margins entire, slightly curved, outer margin produced into a small curved spine slightly before middle, apex truncate, the inner corner slightly produced.

Stramineous; slightly darker over frons and antennæ. Tegmina hyaline with light fuscous marks, over base of clavus extending over base of radial and subcostal and apical half of costal, another





Phenice bicornis, sp. n.

Fig. 2.—Front view of head.
Fig. 3.—Lateral view of male genitalia; *a*, apex of anal segment; *b*, apex of genital style.

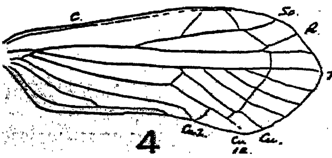
mark from apex of clavus to base of *Ms* 1; a darker mark over cross-vein of *Cu* extending into membrane, the cross-veins of *Ms* and *R–M* dark, veins otherwise light. Wings hyaline, slightly fuscous.

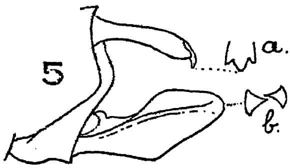
Female.—Length 3·7 mm.; tegmen 6·9 mm.

Antennæ slightly shorter than in male, and the process on the base also shorter. The ovipositor longer than is general in Derbidæ. Pregenital plate with hind margin angularly produced from middle to sides.

Colour similar to male, but with the dark marks over *Cu* and *M* cross-veins darker.

Hab. Njala, Sierra Leone; "at light" (*E. Hargreaves*, Dec. 1928; August, December, 1928). Two males and one female.





Patara hargreavesi, sp. n.

Fig. 4.—Right tegmen.
Fig. 5.—Lateral view of male genitalia; *a*, apex of anal segment; *b*, apices of genital styles.

Patara hargreavesi, sp. n. (Figs. 4, 5.)

Male.—Length 1·9 mm.; tegmen 2·8 mm.

This differs from the typical species of the genus in having a

small subquadrate subantennal plate situate more behind than beneath the antenna. The venation of the tegmen is similar to that of *Patara pattersoni**, the only other species of the genus so far reported from Africa. They both differ from the type, *P. guttata*, in the *Cu* and in having an extra *Ms*, but I consider that they must both come into the genus.

Antennæ not as long as the frons, thick and wide; a small quadrate plate arising from the head behind the antenna, the distal margin bearing hairs. Vertex triangular, small; frons narrow.

Anal segment long, narrow, the apex produced into three small processes, the middle one curved downward. Genital styles long, fairly narrow, widest about middle, where the inner margin is angular, apices pointed and curved inward.

Shiny black; clypeus and legs yellow. Tegmina and wings black with a reddish tinge; apical portion of costal margin reddish, a small light mark at the apices of each vein entering the apical margin.

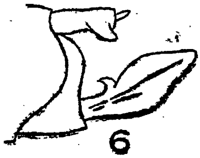
Female.—In size and colour similar to the male. Pregenital plate angularly produced from sides to middle, the two sides of the projecting angle slightly sinuate.

Hab. Kenema, Sierra Leone, on Oil Palm (*E. Hargreaves*, May 1928). Three males and three females.

Patara elœidis, sp. n. (Fig. 6.)

Male.—Length 1·5 mm.; tegmen 2·7 mm.

The antennæ about as long as the frons, broad and flat; no subantennal plate. The venation of tegmen similar to *P. guttata*, with three median sectors and only one branch to *Cu*.



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Patara elœidis, sp. n.
Lateral view of male genitalia.

Anal tube short, the apex produced into two small, conical processes, one on each side. Ventral margin of pygofer straight,

* This was omitted from the list published by the writer in Ann. & Mag. Nat. Hist. (10) i. p. 498. (Fig. 7.)

7

Patara pattersoni.
Right genital style.

sides slightly curved; genital styles large, sublanceolate in outline, a small curved spine on dorsal margin near base.

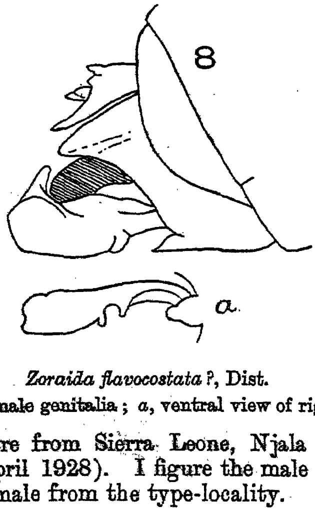
Frons, vertex, antennæ, and thorax yellow, the mesonotum darker; clypeus brown; front legs fuscous, middle and hind legs yellow; abdomen brown. Tegmina and wings fuscous with darker veins, the apical cells of tegmina lighter.

Hab. Sierra Leone, Kenema, on Oil Palm (*Elæis guineensis*, Jacq.) (*E. Hargreaves*, May 1928), one male.

There are three other specimens of this genus, representing two species, but as one is a damaged male and the others females I refrain from describing them.

Zoraida flavocostata, Dist.

This species was described from one female from Kola River, Portuguese East Africa. The specimens before me, which I place



Zoraida flavocostata ?, Dist.
Lateral view of male genitalia; *a*, ventral view of right genital style.

in this species, are from Sierra Leone, Njala (*E. Hargreaves*, Dec. 1927 and April 1928). I figure the male genitalia for comparison with the male from the type-locality.

V.—*On the Multiple Tumours* (Lymphocystis) *of Plaice and Flounders.* By Emeritus Professor W. C. M'INTOSH, M.D., D.Sc., LL.D., F.R.S., Gatty Marine Laboratory, University of St. Andrews.

[Plates I.-IV.]

THIS appears to be the affection mentioned by Dr. Lowe *, who frequently found it in flounders from the Ouse, Norfolk. He described it as a peculiar skin disease resembling epithelioma, large fungus growths cropping out over the whole body. The granulations

* Trans. Norfolk & Norwich Nat. Soc. 1873-74.

are large and roe-like, consisting of large nucleated cells under the microscope.

In the estuary of the Thames in 1883 many common flounders were thus attacked, besides being infected with *Caligi.* Like the haddocks suffering from gill-parasites and the green cod from *Caligi*, the fishes were generally out of condition.

In the third Annual Report of the Fishery Board for Scotland a note on these tumours affecting plaice at St. Andrews was made as follows:—

"The coloured surface of the fish was crowded with the small rounded tumours which resembled shot. They also occurred on the dorsal, ventral, pectoral, and caudal fins, and on the white surface. They are firmly fixed to the skin and give pain to the animal when interfered with. Moreover, they are vascular, free hæmorrhage occurring when they are injured. The isolated tumours range from 1·7 mm. to 1 mm. or less. The larger masses, when bisected, show a series of smaller areas, the whole being composed of multiple tumours [cells] mostly of the same size. When cut into in the fresh state, a whitish-creamy substance exudes, which, under a power of 400 diameters, is minutely granular, no distinct cell-elements being visible, though fine fibrillæ occur throughout the field as if the fluid were coagulable. In section [with a scalpel] the large tumours present a series of loculi, or spaces filled with the granular creamy fluid. Each chamber is cystic, presenting a firm hyaline wall of considerable thickness, within which is the granular contents. The stroma exterior to the hyaline coat is chiefly fibro-granular. Amongst the larger cysts are numerous smaller forms in course of development, the thick, translucent, hyaline wall being conspicuous" *.

Further examination † of a large multiple tumour projecting from the mouth of a flounder at St. Andrews showed that the fluid escaping from "the cut surface contained masses of small granular cells with distinct nuclei—these apparently being external to the encysted bodies forming the tumour, for the contents of the cysts were mainly granular."

Mr. George Sandeman ‡ subsequently examined these tumours at St. Andrews in 1893, observing that "an individual cyst is surrounded by a hyaline membrane, and is in close connection with the inner surface of the skin, which is always unbroken over it. The pearly-white sphere has no deep attachment, but lies in loose connective tissue. On pressure it bursts, and exudes a white, creamy, granular substance. . . Their enclosing membrane is hyaline and apparently structureless (pl. xvii. fig. 5) but for a radial striation in the inner layer, which gives it a resemblance to an egg-membrane with a *zona radiata*. . . It gives the staining reactions characteristic of yolk. . . The larger masses vary in size and shape, ranging from a tumour formed of two or three cysts to one an inch in length and half an inch in diameter. They

* S. F. B. Rep., Appendix, pp. 66–67, 1885.
† *Ibid.* No. 4, Appendix, p. 214, 1886.
‡ *Ibid.* for 1892 (1893), pt. 3, pp. 391–392, pl. xvii. figs. 1–7.

may be broad at the base, but are usually narrow and projecting, sometimes even pedunculated." Between the cysts "is a varying amount of tissue, especially abundant near the base of the tumour, and consisting of fibrine and leucocytes, or of more or less advanced connective tissue, in one case of myxomatous tisssue. . . Young blood-vessels are usually present." The author thought they were unlike any known Protozoon or Protophyte, and mentions that the present writer once found *Diplozoon paradozicum* in one of the tumours.

Dr. Woodcock *, in his careful description, observes, in regard to the cysts in the mesentery, that they are smaller than those outside—never exceeding 1 mm. in diameter. He supposes that when small they pass into the blood-vessels (capillaries) or lymph-channels from the gut, and then grow and encyst, "since in sections they are surrounded by a space." He found all the other viscera normal, so that the hosts did not appear to be seriously harmed. The cysts increase in size, but each remains a single cell, and he found no trace of cell-nuclei nor of cell-division. In his fig. 3 (pl. iii.) he gives a section, minutely covering the structurless investment with dots (never seen by the writer), the "capsule being surrounded by a layer of amœbocytes closely aggregated." Next comes a thick deeply-staining zone of a finely granular nature, the greater part of which gives the organ its character. "Centrally is a huge nucleus with a very thin nuclear membrane (from a cyst underneath the skin), and in it several nucleoli or karyosomes (since they retain the chromatic stain)." He considered these bodies unlike any known Protozoan, and he gave the name *Lymphocystis johnstonei* to them. He considered the tumours masses of cysts "with, of course, a little vascular connective tissue between and around them."

A. S. Awerinzew † procured a flounder with this sporozoan parasite in the mesentery, liver, ovary, as well as in the skin of the fish. The shape was generally ovoid, and it measured from 1 to 3 mm. in diameter. Out of 109 flounders 19 were affected, or 11 per cent. He alluded to the observations of Johnstone and Woodcock, pointing out that the Myxosporidian had the structure of the genus *Henneguya*, and thus he called Woodcock's form *H. johnstonei*. He found the youngest stage disk-shaped and measuring 0·060 to 0·090 mm., with an ectoplasmic tail (0·011 mm.), a cirrus of endoplasm, and a nucleus in the endoplasm. He goes into detail in regard to nuclei and nucleoli and their staining. The spore subsequently loses its tail. He did not allude to the structure of the wall of the tumour.

Two papers on the allied type, *Glugea*, by R. Weissenberg ‡ appeared in 1911 and 1913. In the first of these an account is

* Rep. xii. Lancashire Sea-Fisheries Lab. 1903, p. 63.

† "Leiter der mariner Biol. Murman," Zool. Anz. Bd. xxxi. no. 26, July 9, 1907 (with text-figs).

‡ Arch. f. Micros. Anat. Bd. lxxviii. p. 383, Taf. 18 & 19; *ibid.* lxxxii. p. 81, Taf. iv.–vii.

given of an attack of the parasite on the central nervous system of *Lophius piscatorius*, and descriptions and figures closely approach those met with in the "multiple tumours" of plaice and flounders; yet, so far as the investigations have gone, none of the minute spores characteristic of *Glugea* have been encountered, though it is possible such early stages have been passed before the introduction of the parasite into the tumour. Moreover, Weissenberg shows that the capsule of the young *Glugea* is uniformly smooth amidst the nerve-cells; and he alludes to the budding chain (Sproskettten) of the schizont in the outer zone of the young *Glugea*.

In the second paper he treats of the minute structures of *Glugea anomola*, Moniez, and of *G. hertwigi*, Weissenberg, the former occurring in the stickleback and the latter in the smelt. He deals exhaustively with both species, and figures the spores of *G. hertwigi*.

In a plaice procured in St. Andrew's Bay on the 15th August, 1895, a tumour nearly half an inch in diameter was situated behind the left eye and attached to the surface by a narrow pedicle (Pl. I. figs. 1 & 2), and thus had a certain amount of motion (Pl. I. figs. 1*a*–1*b*). Externally the surface was everywhere raised into the little eminences from the development of the egg-like cysts internally. On cutting through the tumour the entire contents consisted of these cysts, which varied in size from a quarter or less to 5 or 6 mm. In structure the surface of the section presented a fibro-granular matrix surrounding the cystic bodies, each of which had a structureless gelatinous investment of varying size, the interior being opaque and granular. On the left (pale) side of the fish (Pl. I. fig. 1*a*) four flattened circular bodies were present, two towards the ventral and two near the dorsal margin and about half an inch from the dorsal fin. Each of these had the same cystic contents surrounded by the fibro-granular matrix. Further, besides the larger cysts in the sections of the fresh tissue, there were groups of much smaller forms, some of a nearly uniform size as well as others scattered singly, and such necessarily raised the question as to their origin. No sign of the development of these smaller bodies in the larger has ever been seen; nor can they arise from the fibro-granular matrix. In looking over the field of a preparation, a more distinctly cellular structure was once met within, the cyst, apparently of one size over the whole area; but such may have been due to preparation and pressure. No distinct gelatinous investment was seen in these cases. The appearance of this cyst resembled that figured by Weissenberg * in the upper part of the lower (right) cyst in fig. 7 (pl. xix.) in *Glugea lophii*, Doflein.

The field of a section of the entire turmour has the larger cysts occupying most of the space and surrounded by the general fibro-granular tissue, in which also groups of the smaller cysts and

* Arch. f. Micros. Anat. Bd. lxxxviii. 1911.

blood-vessels occur. The smaller (developing) cysts have no definite distribution, occurring throughout sometimes in groups of about 20 or more (Pl. II. fig. 14). This represents a group of a dozen small cysts nearly of equal size, a larger one being below. It is seldom that so considerable a series of almost uniform size is met with, irregular sizes (as in Pl. III. fig. 8) being more common. They may even reach the proximity of the investing layer, though such is generally the seat of the larger cysts. The latter show within the translucent gelatinous coat the "Plasmaschale" of Weissenberg, a mass of granules, whilst in the centre is a gelatinous area often with numerous processes or rays. Sometimes a median cyst (Pl. I. fig. 1) has a separate opaque granular area and a more translucent gelatinous area, as if the whole had undergone division, but such appears to be due to changes during the preparation, which also cause the gelatinous investment ("ectocyst"; "Plasmaschale," Weissenberg), often to shrink into a linear belt in section, and it is occasionally doubled or folded, each fold separated by a layer of granules (Pl. I. fig. 2). In some of the smaller cysts amœboid forms akin to those described by Awerinzew appear (Pl. I. figs. 4 & 4 *a*).

The tumour is highly vascular, and the field contains many blood-vessels—large and small—within some granular blood (corpuscles) or opaque bodies. Thus a minute larval form such as that described by Awerinzew might readily be introduced, and, indeed, in the smallest or first stage of the cyst is apparently present; once introduced, the larva, in the midst of rich nourishment, would seem simply to enlarge by compressing the surrounding stroma which alone forms its investment (figs. 5, 5 *a*, & 6), the former representing a blood-vessel containing a foreign body stained, the latter showing a pale investment. Occasionally the section of a vessel presents within its definite deeply-stained wall only a translucent, finely-reticulated substance; but, on searching its further course, corpuscles appear—thus demonstrating its nature. Such a vessel would contain a parasite of considerable size.

Some of the minute cysts show only an indefinite border to the cavity and a small circle of the structureless ectocyst (the gelatinous layer), within which are a few granules. In the most minute there is simply a black (stained) centre without an evident ectocyst, or perhaps only a trace of it at the circumference. Such is readily distinguished from a small blood-vessel by the well-defined wall of the latter—whereas the cystic wall is only part of the surrounding stroma (Pl. I. fig. 12 *a*). The occurrence of the smaller cysts in groups here and there may indicate occasional epochs of infection. The next stage to fig. 12 (Pl. I.) is the formation of the structureless ectocyst with the densely granular centre; the gelatinous substance in the early amœboid stage seems to be rapidly separated to form this investment.

The so-called fibro-granular matrix around and between the cysts appears to be formed of fine strands of the gelatinoid substance which plays so important a part in these parasites. The

addition of the stain covers the field of these strands with multitudes of minute dark granules which vary in size and shape and seem to be due to the action of the stain on the constituents of the fibres themselves, being minute in much of the stroma, coarser and in rows in other parts. This tissue supports the numerous blood-vessels—large and small—throughout the tumour, and it is curious to note its divergent condition in the tumour on the tail.

When two adjoining cysts are cut obliquely, it is clearly shown that the narrow process of the stroma around and between them forms no special capsule for each cyst—a fact not in accordance with Dr. Woodcock's statement and figure * in those from the mesentery. Each cyst, he states, lies in a space "representing an enlarged capillary or lymph-chamber. It is surrounded by a layer of amœbocytes rather closely aggregated." In a more highly magnified section of the same cyst (fig. 6) he shows the external layer of a "thick, faintly-staining structureless membrane (*ect.*). Next comes a thick zone, more deeply staining, finely granular, the greater part of which presents a most unusual appearance and gives the organism its remarkable character. Centrally is what can only be a nucleus (N.). In each nucleus are several nucleoli, or rather karyosomes, since they retain chromatin stain. The nuclear membrane is very thin and irregular, and sometimes seems only a boundary between the nucleus and the inner limit of the critical region."

In studying the various sections † after staining with iron hæmatoxylin, the tumour presents externally a superficial series of circular areolæ (Pl. I. fig. 7 *a*), which vary a little in size in the stroma. These project in some cases as clear vesicles on the free edge, and give a character to the surface. The deeper part (Pl. I. fig. 7 *b*) of this thick layer is minutely cellular throughout, forming a compact investment. Within is a fibroid layer (Pl. I. fig. 7 *c*) profusely dotted with black points (stained), especially on its inner edge, so that it forms a nearly continuous black border against which the paler ground-tissue of the tumour rests—this, as a rule, intervening between the walls of the cysts and the inner cortical (dermal) layer. The subdermal fibroid layer might be mistaken for a muscular coat, but it is essentially different, being composed of fibrils (Pl. IV. fig. 18), which here and there have dilatations and contractions as if protoplasmic—which it really seems to be, though the continuous arrangement of the more or less separate fibrils is striking. The coat is, perhaps, less developed in this tumour than in that attached to the tail, as will subsequently be shown.

The cysts (Pl. I. figs. 2, 4, & 7 and Pl. II. figs. 13, 14, & 15) present diverse aspects in the sections, and the translucent, friable, gelatinous investment is much altered. In some the contents are

* Rep. Lancast. Sea Fish. 1904, pp. 65 & 66, pl. iii. fig. 3.

† Which I owe to the kindness of Prof. Stanley Gardiner, of Cambridge University. They were made by his assistant in the Laboratory, Mr. Drury.

deeply stained with large black granules throughout, or with rows of granules like chains, whilst the cyst may be split into two parts, an outer part of dark granules and a central gelatinous mass with various processes only slightly stained, or the whole area forms a network of fibrils with scattered dark granules. Occasionally the gelatinous ectocyst forms a double loop fused in the centre, each chamber thus being separated (Pl. II. fig. 13). In certain cases it may be that rupture of the interstitial tissues takes place, so that the ectoplasm of two adjacent cysts fuses. Besides the characteristic translucent investment the larger cysts have the same substance in their interior, and it gives rise to numerous striking figures—from solid central masses to brush-like or arborescent strands and intricate reticulations, the latter affecting in some instances a double chamber (Pl. IV. fig. 16). The size of the cysts ranges from ·5 mm. (Pl. I. fig. 12) to 8 or 9 mm. or more. Early stages of the cysts are also shown in Pl. II. (fig. 14) with undefined walls, and so close were they that their oval shape was probably due to pressure. A faint ectocyst appears in the upper figure. In another minute stage (Pl. I. fig. 5 *a*) the cyst was U-shaped, and no granular contents were in the section. Occasionally a cyst occurs in the section in which the central ovoid mass is separate from the gelatinoid layers, and apparently retains its shape by the nature of its substance, which consists of stained granules each surrounded by a protoplasmic investment (Pl. IV. fig. 22). Whether this was due to the effects of the preparation for section or otherwise is doubtful, but it resembled the conditions in its allies. Such appearances were unconnected with the origin of the young cysts. In the majority of the larger cysts the large stained granules form a belt externally, but they varied in size, were often devoid of a gelatinous investment, and in no case could they be identified with spores. Again, swarms of oval spores occur in Weissenberg's *Glugea* in the stroma surrounding the cysts as well as in the external region of the cyst. His vegetative and other "Kernes" likewise differ. The occurrence of the secondary capsule and general cellular condition also diverges. Thus there was an essential difference between them and *Glugea*; yet there was much in common. The subdermal gelatinoid fibrils in this form (*Lymphocystis*) are less developed than in the second form, but they have the same character. They do not, however, penetrate as large fibrils into the body of the tumour, the translucent finely granular stroma, already described, occupying the whole of the interstitial region. It is true a slight development of the coarse fibrils here and there takes place between two cysts, but it does not extend far inward. Moreover, the boundary of the narrow subdermal gelatinoid layer internally—all round—is better defined than in the form on the tail.

Whilst no separate and definite layer intervenes between the structureless gelatinoid investment and the stroma around, the central mass often presents an entire margin, the granular contents adhering evenly exteriorly. In certain cases a distinct thin line

envelops the granular contents, a feature due to the transference of the gelatinoid substance from the central region to the surface, and independently of the more conspicuous structureless investment. The histology of the cysts has been minutely studied by Woodcock, and he ends by asserting that each is an organic unit. After much discussion and comparison with *Lymphosporidium* of the brook-trout epidemic in America, he concludes "that *Lymphocystis* appears to combine, to a certain extent, Gregarine and Microsporidian characters with remarkable results."

In the preparations the cells presented numerous stained granules, large and small, and occasionally a large central "nucleus" surrounded by a dark ring; but the latter appeared to be only a phase in the arrangement of the mobile contents, and was subject to infinite variety.

Prof. Johnstone's * two slides of the same form from the skin of a sole (external to the scales) presented few and comparatively small cysts, but each had the structureless ectocyst or gelatinous investment and the granular contents. Two additional slides, from the same source, of the ovarian region of the cod (Sept. 1925) showed, in the first, part of the ovary (stained blue) with an "angio-sarcoma" in the centre (coloured red). In the delicate stroma several bodies like the Myxosporidian cysts occurred, but these and some in the tumour itself could not be identified satisfactorily. The latter differed from the true cysts in filling the space entirely, and were devoid of the characteristic ectoplasm. In the other preparation were certain large circular ova near the margin of the central tumour and in the centre of the latter itself, but they differed from the cysts. There were also certain large rounded masses, one showing a pale ectoplasm, and the mass appeared to be dividing into two, but the investing tissue was too dense and the smaller masses outside agreed with ordinary ova. The isolation of these (which stained like the tumour) and their structure differed from the conditions in the true cysts.

The Second Tumour.

The rays of the tail-fin in a plaice, from St. Andrews, of medium size were the seat of a diffuse and somewhat nodulated tumour (Pl. II. fig. 21) which extended about half an inch from the right or lower edge to the dorsal or left edge, commencing in front behind the bony skeleton and passing backward to the extremities of the rays. The thick, firm, mass fixed the rays, and somewhat distorted the fin so that its functions were much interfered with. The rays of the distorted fin were almost indistinguishable on the left base either dorsally or ventrally, but on the right they were distinct from the base to the tip for an area fully half an inch in breadth, all beyond this area being involved in the tumour both dorsally and ventrally. The complete entanglement or absorption

* I have to thank Prof. Johnstone for his kind courtesy on various occasions.

of the rays by the tumour was noteworthy, and consequently the fin was considerably shorter on the left side and generally asymmetrical. Little could be made out with the naked eye on section beyond a uniform solid tissue, which appeared to incorporate the the rays in its substance, surrounding them with a growth of firm tissue. Microscopically the external investment was akin to the normal, and to that covering the previous Myxosporidian tumour, viz., a superficial layer of cells or vacuoles, and a thicker inner layer of minute cells abutting on a deeply-stained belt of gelatanoid fibrils beneath.

Within the foregoing is a series of cysts (Pl. IV. fig. 17), each showing a thick corrugated band that seems to be the homologue of the structureless ectoplasm of the previous form, and which frequently makes an incomplete investment, for it ends in a granular or reticulated mass at one side. In the larger cysts, however, the investment is often complete, the centre of the cyst being occupied by a translucent reticulated mass with small clear vesicles, thus differing from the condition in the previous Myxosporidian. The stained gelatinous investment (amœboid) often forms a mass at one end (Pl. IV. fig. 16). The cysts rarely extend into the dermal tissue, but lie in the subdermal fibro-gelatinoid layer, and each has its opaque band (stained), which occasionally is spirally rolled. In certain spaces, again, large masses of the gelatinoid substance occur near dense fibroid growths in the interstitial tissues, thus wholly differing from the condition in the previous form.

The subepidermal gelatinoid layer forms considerable offshoots here and there with the cysts in it; indeed, it seems to be the only tissue in which the cysts are, and it always has a coarse fibrillar aspect from the parallel threads or chain-like tissue. These fibres show constrictions and dilatations, especially on the inner border of the subepidermal layer (Pl. IV. fig. 18). The occurrence of these slender parallel fibrils of the gelatinoid substance throughout the entire tumour is characteristic, and they sometimes lie in the centre of 10 or 12 cysts, processes passing between them.

In the sections the subepidermal layer of fibrils occasionally throws out a leaf-like ridge having very fine ramifications of its fibres (Pl. IV. figs. 3 & 19), a central trunk at the base leading with others, which are lateral, into the ridge. The fibres inosculate with each other in their course. In some of the cysts, again, translucent reticulations (protoplasmic) radiate from a central mass.

The colour of the gelatinoid masses in the stained sections is by transmitted light slightly brown, like the belts in the cysts, whilst the other tissues are bluish, except the finely-reticulated interstitial tissue and the central reticulation of the cysts. In certain slides the outer edges of the interstitial tissue are also tinted bluish. The breaking-up of two large gelatinoid masses into finely-reticulated fringes, which may join the folded interstitial tissue, is a prominent feature, and the amalgamation is complete. The coarser gelatinoid tissue seems in this form to take the place of the finer translucent tissue forming the general stroma in the former species.

It stains slightly, but sometimes not at all in the central parts, and is thus in contrast with the subdermal and other parts of the gelatinoid fibrillar tissue.

When crushed from their position (centre) in a section on a slide, the cells of this form sometimes cling together, as in Pl. III. fig. 23, a feature not hitherto seen in the other type. Such would appear to indicate that the surrounding tissue forms a more definite boundary-wall than in the latter. The stained ectoplasm is seen in two of the cysts in the figure.

Viewed broadly, much of the area of this tumour in section is occupied by curiously folded translucent masses (Pl. II. fig. 24) with numerous small blood-vessels. The tissue, indeed, resembles the folding or doubling of endless tubes, and is probably a product of the prevalent gelatinoid tissue, which forms a border to it, and in which the blood-vessels lie. The tissue varies in appearance, being more loosely or more finely reticulated, and sometimes ending in thread-like processes at a corner. Some of the masses, again, near the opaque bands of gelatinoid substance are formed of closely-arranged fibres so that they are less transparent, the one often joining the other by a coarsely or a finely-branched border. With the exception of the blood-vessels, the entire tumour, within its investment, is constructed of the same gelatinoid tissue in its several modifications, with the addition of the Myxosporidian parasites. The presence of the latter is probably the cause of this remarkable growth, which, however, assumes, by its incorporation of the fine rays and its great vascularity, a more or less malignant aspect. It is further interesting that a somewhat finer variety of the same translucent gelatinoid tissue occurs in the interior of each Myxosporidian in the tumour. Thus a striking uniformity is maintained throughout the mass.

The walls of the large blood-vessels are formed of firm fibres, the blood-corpuscles occupying the centre, and smaller trunks are shown (Pl. II. fig. 24, *b.v.*). The tumour is throughout highly vascular, and evidently in a state of active function.

The differences between this and the former Myxosporidian rest in the greater development of the gelatinoid fibrillæ in the present form, and the substitution of the irregular strands of the same substance for the much finer fibro-granular stroma of the former tumour, as well as in the nature of the cysts with their translucent and finely-reticulated gelatinoid contents. Moreover, developing forms are there present, whereas in the tumour on the tail such are only represented by the slightly smaller processes at the margin—under the dermal layer. No minute forms or spores were seen. The facies of the two differed. The large cysts in the tumour from the tail were studded in single file along the surface with a broad belt of the fibro-gelatinoid layer internally with other cysts.

Glugea in section somewhat resembles the first-mentioned tumour; but there is no ring of spores, only the structureless ectocyst, nor is the swarm of oval spores present in the stroma between the cysts.

These tumours appear to belong to the group of Phænocystes or intercellular parasites, in contradistinction to the Cryptocystes or cellular parasites. The trophic stage seems to be amœboid, as shown in the varied shapes assumed in the sections, the gelatinous exterior often forming lobate processes, whilst the interior is granular. Nothing in the life-history, so far as known, is comparable to the complex cycle of such as the Coccidian, *Aggregata eberthi**, in which schizogony occurs in the gut of *Portunus depurator*, whilst the merozoites which penetrate the intestinal wall of the cuttlefish grow into large mero- and smaller microgametocytes.

The origin of these parasites is at present in obscurity, but it may be connected with a crustacean such as *Portunus* or an annelid like *Lagis koreni*, the latter carrying a gregariniform parasite which develops into *Eugregarinellospora lagidis*.

EXPLANATION OF THE PLATES.

Plate I.

Fig. 1. Dorsum of plaice with pedicled tumour; 1 *a*, ventral surface with four small tumours.
Fig. 2. Cyst with double layer of ectocyst.
Fig. 2 *a*. Tumour on head of plaice enlarged.
Figs. 4 & 4 *a*. Varieties in the shape of the smaller cysts in the first type.
Fig. 5. Blood-vessel containing foreign body. × 360.
Fig. 5 *a*. Minute cyst with U-shaped gelatinoid mass. × 200.
Fig. 6. Small cyst showing translucent ectocyst, and stained (opaque) centre.
Fig. 7. Section of the wall of the tumour. *a*, superficial cells; *b*, minute cells; *c*, gelatinoid fibrilla layer; *d*, cyst.
Fig. 7 *a*. Superficial epidermal vesicles on the surface of the tumour. × 350.
Fig. 12. Early cyst (opaque) without trace of ectocyst externally.
Fig. 20. Small cyst in which the ectocyst touches the surrounding stroma. × 60.

Plate II.

Fig. 13. A large cyst in which the gelatinoid ectocyst forms a double cavity (*a* & *b*) after preparation. × 60.
Fig. 14. Two minute developing cysts, each with traces of the ectocyst externally, the granular centre being stained. × 60.
Fig. 15. A group of small cysts of nearly uniform size. × 60.
Fig. 21. Tail of a plaice bearing a malignant (?) tumour incorporating many of its rays. Nearly natural size.
Fig. 24. Section of a portion in the centre of the foregoing tumour showing the gelatinoid fibres and blood-vessels at the margin, and the complete tube-like arrangement of the central tissue. × 60.

Plate III.

Fig. 8. View of a portion of a multiple tumour (*Lymphocystis*) with developing cysts of various sizes, and a larger one below. *ec.*, ectocyst; *g.*, granular centre; *v.*, blood-vessel. × 80.
Fig. 23. Three adherent cysts from the tumour in the tail. × 60.

* Biol. Rev. Biol. Proc. Camb. Philos. Soc.p. 163, April 1924.

PLATE IV.

Fig. 3. Bifid ridge from the subcutaneous fibro-gelatinoid layer. × 60.

Fig. 16. Section of two cysts from the foregoing tumour, the left with the ectocyst ending in a mass, the right having the ectocyst all round. × 60.

Fig. 17. *Section of cysts from the surface of the tumour of the tail.* × 60.

Fig. 18. Fibre-like strands, with dilatations and contractions of the subcutaneous layer from the tumour of the tail. × 60.

Fig. 19. Section of a ridge of the same layer showing a leaf-like pattern. *a*, areolar surface-layer; *b*, finely cellular layer. × 60.

Fig. 22. Section of a cyst from the head of the first-mentioned plaice in which the contents appeared to be cellular, though probably a result of preparation.

VI.—*Notes on Neotropical* Pselaphidæ (*Coleoptera*), *with Descriptions of new Species.* By FRANK C. FLETCHER, Minneapolis, Minn., U.S.A.

THIS is the first of a series of short papers on South American Pselaphidæ, in which I shall give descriptions of miscellaneous new species, notes on others, and revisions of small groups of species.

Contributions to this fauna already published will be found in Ann. Ent. So. Amer. 1928, xxi. pp. 203–230; Trans. Amer. Ent. Soc. 1928, liv. pp. 69–77; and Ent. News, 1927, xxxviii. pp. 149–153.

Unless otherwise stated, all types are to be found in the personal collection of the author.

Arthmius (*Arthmius*) *scaphiger*, Sharp, Biol. Centr.-Amer. ii. 1, 1887, p. 13.

Described as coming from Mexico with query, not recorded since. There is a single male in my collection from Jalapa, Mexico.

Arthmius (*Arthmius*) *subfusus*, sp. n.

♂. Elongate, narrowed anteriorly; bright rufo-testaceous, abdomen darker; scarcely perceptibly punctulate, strongly shining; pubescence pale, sparse, and rather short.

Head quadrate, including eyes considerably wider than prothorax; eyes very large, convex, coarsely faceted; dorsal surface very smooth, evenly and slightly convex over the entire surface, no impressions or foveæ of any kind; front and epistoma evenly declivitous, continuous with the vertex; sides evenly rounded; antennal tubercles not prominent.

Antennæ slender; second segment oval; third somewhat transverse, broader at apex, produced on outer side; fourth very transverse, dilated, one-half wider than second, the inner surface somewhat concave, covered with glandular hairs; fifth of about

the same form as fourth, but wider and somewhat produced on outer side, surface likewise covered with glandular hairs; sixth greatly expanded on outer side, auriculate, fully twice as broad as second, the edge fringed with dense white hair; seventh subquadrate, narrowed, not wider than second; 8 of about the same form, but slightly wider and more transverse, 9 and 10 subglobular; 9 distinctly wider than 8, 10 wider than 9, 11 elongate-conical, about equal to the three preceding together; the last three segments forming a distinct club.

Prothorax about equal in length and breadth, widest in front of middle, strongly rounded, then rapidly but evenly narrowed to base; surface smooth, glabrous, convex, not sculptured, with the usual basal transverse sulcus not prolonged at the sides.

Elytra slightly transverse, widest in apical third; humeri evident, but not pronounced; surface convex, with fine sutural striæ, but no discal striæ; punctuation consisting of minute scattered punctures, each bearing a hair.

Abdomen with last ventral large and broadly concave.

Legs modified as follows: anterior tibiæ swollen in middle and slightly notched at outer side near apex; posterior femora with a thin line of fine pale pubescence along the inner length; posterior trochanters with white hair.

Length 1·6 mm.; breadth 0·8 mm.

One male, from Jalapa, Mexico.

This species belongs in that section of *Arthmius* characterized by the modified antennæ, but it is widely different from any of the described species. The type of antennal modification is unique in the genus, and this with the unsculptured head makes this species very easy of recognition.

Arthmius (*Arthmius*) *extraneus*, sp. n.

♂. Elongate, convex, narrowed anteriorly; dark testaceous in colour; not perceptibly punctate, very shining; pubescence pale and very sparse.

Head somewhat longer than wide; width including the eyes equal to that of the prothorax; eyes moderate, coarsely faceted; vertex slightly convex, sides without margins or carinæ; a pair of very deep sharp foveæ between the eyes, closer to them than to one another; these foveæ do not give rise to a sulcus; front just behind the antennal tubercles with a pair of small shallow impressions separated only by a ridge; front evenly declivitous to epistoma; antennal tubercles distinct, but not prominent, smooth.

Antennæ slender; segments 2 to 8 all longer than broad; second oval, slightly longer than broad; third a little narrower and very slightly obconic, one-half longer than broad; 4 of same form, length, and width; 5 of same length, more obconic, distinctly wider than 4 or 6; 6 a little shorter than 4, decidedly longer than broad, of same form; 7 just perceptibly wider than 6, of same form, a little over one-half broader than it; 8 much shorter, but still distinctly longer than broad, of same form and width; 9 suboval, distinctly wider, almost one-half longer than broad; 10 about

equal in length and width, much wider, widest at middle; 11 not much wider than 10, elongate-conical, equal to the two preceding together; last three forming a fairly distinct club.

Prothorax just equal in length and breadth, strongly rounded in anterior half, then rapidly narrowed to base; disk very convex, with no sculpture other than the usual transverse basal sulcus.

Elytra slightly transverse, widest in apical third; humeri distinct; disk convex, with the usual sutural striæ, three basal foveæ on each elytron, and lack of discal striæ; surface very sparsely covered with minute asperities, each bearing a hair.

Legs simple, except for the anterior, which are modified as follows: femur with an acutely margined, very deep, circular fovea in the middle of its superior surface; the exterior edge of this fovea is prolonged upwards in a point; joined to this prolongation is a long, high, finely crenulated ridge, extending from the fovea longitudinally to almost the apex of the femur; apex of tibia with a bunch of rather long, apparently glandular hairs. Middle tibia with a distinct mucro near apex; middle trochanter without trace of any but the usual pubescence.

Under surface. Metasternum with a deep longitudinal sulcus; apical ventral segment with a very deep irregular fovea in apical half.

Length 1·9 mm.; breadth ·8 mm.

Described from one male from Corumba, Matto Grosso, Brazil.

This species is very closely related to *cicatricosus* and *brevicollis*, both described by Raffray. I have not seen a specimen of *cicatricosus*, but I have one of *brevicollis* in rather poor condition from the type-locality, Minas Geraes. *Cicatricosus* was described from Central Paraguay. To elucidate the differences between the three species, I append the following table:—

Antennal tubercles smooth.

Head with a semicircular sulcus interrupted at middle. Antennal segments only slightly longer than broad. Fovea of anterior femur oblong, without longitudinal carina. Middle trochanter with slight brush of hair. Terminal ventral segment impressed almost over its entire surface, with a little tubercle at middle ..... *cicatricosus*, Raff.

Head with a deeper semicircular sulcus, likewise interrupted at middle, but with a little tubercle. Segments of antennæ a little longer than broad. Fovea of anterior femur oblong, without carina. Middle trochanter normal. Terminal ventral segment with a very deep fovea at middle ..... *brevicollis*, Raff.

Head without trace of sulcus, but with two very approximate foveæ in middle behind antennal tubercles. Fovea of anterior femur absolutely circular, with high crenulated crest running longitudinally. Middle trochanter simple. Terminal ventral with a broad irregular depression in apical half, occupying about one-half of segmental width; this impression is suddenly deeper at the apical margin ..... *extraneus*, sp. n.

Arthmius (*Arthmius*) *rubriculus*, sp. n.

♂. Slender, narrowed anteriorly; rufo-testaceous, elytra paler; hardly perceptibly punctulate, very shining; pubescence scattered, pale.

Head subquadrate, width including eyes very slightly less than that of prothorax; sides parallel, not margined; eyes moderate, coarsely faceted; entire front and epistoma, from one antennal tubercle to the other, evenly depressed, the surface almost vertical; the surface of the front and epistoma is smooth and shining, but covered quite thickly with minute tubercles, when viewed under high power each tubercle is seen to bear a fine bristle; vertex slightly convex, with a pair of large foveæ between the eyes, no sulcus; surface smooth and shining; antennal tubercles slightly prominent, rendered so by the depression of the front and epistoma.

Antennæ rather stout; first segment simple; second oval, slightly broader than the next; 3 not much longer than broad, narrower at base; 4 of the same length, width, and form as 3; 5 a little longer, of the same form and just perceptibly thicker; 6 shorter than 5, of same width as 4 and 5; 7 more oval, of same form as 6, just perceptibly wider; 8 almost quadrate, distinctly shorter than 7; 9 oval, broader, and as long as 7; 10 of about the same length, broader, widest at middle; 11 oval, acuminate at apex, slightly longer than the two preceding together, the last three segments forming a distinct club.

Prothorax almost one-sixth broader than long, sides widest and strongly rounded in apical half, then rather gradually narrowed to base; disk convex, smooth, sculptureless except for the usual basal transverse sulcus.

Elytra slightly transverse, widest in apical third; surface convex, with the usual sutural stria and the three foveæ at base of each elytron; no distal stria; surface sparsely covered with small points each with a hair, particularly conspicuous on the interval between the sutural stria and the suture.

Legs simple, except for the anterior femora, which are modified as follows: femur with a rather deep oval fovea in apical third; exteriorly to it the femur is cut by a transverse groove or notch. Middle tibia with a short, blunt, inconspicuous mucro near apex.

Under surface modified as follows. Metasternum with a deep longitudinal groove, the edges of which are rounded. Terminal ventral segment with a deep almost circular cavity with rounded edge in apical three-fourths, and occupying about two-fifths of the segmental width. Intermediate trochanter with the usual pubescence.

Length 1·4 mm.; breadth ·6 mm.

Described from one male from Corumba, Matto Grosso, Brazil.

Rubriculus is closely related to *cruralis*, Raffray, likewise described from Matto Grosso. It may at once be known by the

peculiar cavity of the front and epistoma, the lack of any cephalic groove, and the anterior femur lacking any trace of a ciliated carina.

Arthmius (*Arthmius*) *mancus*, sp. n.

♂. Elongate, slender, narrowed anteriorly; rufo-castaneous in colour; not perceptibly punctate, very shining; pubescence pale, scattered.

Head quadrate, width, including eyes, about equal to that of prothorax; eyes moderate in size, coarsely faceted; vertex moderately convex, with a pair of deep foveæ near the eyes; slightly anterior to these foveæ the front is posteriorly slightly elevated above the surface, rendering it sharply defined from the vertex, from one side of the head to the other; the entire front is almost flat and descends almost vertically, the flat surface extending completely across the head, obliterating the antennal tubercles; this flattened surface is shining and thickly covered with small tubercles; before the insertion of the antennæ, before it joins the epistoma, the front is transversely concave, but still covered with the minute tubercles; the epistoma itself is prominent, and, like the front, is covered with the tubercles.

Antennæ long and slender; first segment simple; second elongate-oval, broader than the immediately succeeding; 3 and 4 of about the same form, obconic, 3 perceptibly thicker than 4, both equal in length to 2; 5 and 6 equal in width, 5 distinctly longer than 4; 5 to 7 subcylindrical, 6 of same form as 5; 7 subequal in length to 6, just perceptibly wider; 8 just slightly longer than broad, narrower than 7; 9 distinctly broader, about equal to 7; 10 suboval, broader, widest near apex; 11 elongate-conical, a little longer than the two preceding together, the last three segments forming a distinct club.

Prothorax about equal in length and breadth; sides widest and broadly rounded slightly in front of middle, then rapidly narrowed to base; surface convex, smooth, polished, sculptureless except for the transverse basal groove.

Elytra slightly transverse, widest in apical third, convex, with the usual sutural stria and three basal foveæ on each elytron; surface smooth, sparsely covered with minute tubercles each bearing a hair, the tubercles more distinct in a single row on the interval between the suture and its stria.

Legs simple, not modified in any way; middle tibia with a mucro at apex.

Under surface modified as follows: metasternum with a deep oblong foveæ at middle; first ventral segment with a thin, posteriorly-directed ligula, the last with a deep, somewhat transverse depression occupying its entire length and most of its width; intermediate segments very short.

Length 1·4 mm.; breadth ·6 mm.

Described from one male from Corumba, Matto Grasso, Brazil.

By abdominal and cephalic structure this is a species obviously belonging in the group containing *cruralis*, *cicatricosus*, *brevicollis*, and the just-described *rubriculus*, a grouping which was made by Raffray because of the modified anterior femora of the males. It is, indeed, remarkable that *mancus* should be so close to these and have absolutely simple anterior femora. In addition, *mancus* may at once be recognized by the sharp separation between front and vertex, ligula of first ventral, much larger excavation of the last ventral, and other characters.

VII.—*The Classification of the British Carboniferous Brachiopod Subfamily* Productinæ. By Helen M. Muir-Wood, M.Sc., F.G.S.

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During the last fifteen years much has been written on the subject of *Productus*, and more detailed investigation of the many species belonging to this genus has led to its subdivision into at least twenty genera or subgenera by Thomas, Chao, Fredericks, Muir-Wood, and others. There are, however, at least three well-defined groups of species still included in the genus *Productus* (sensu stricto). Recent researches have shown that this genus should be even more precisely limited to a small group of species having a peculiar internal structure.

The genus *Productus* was described by James Sowerby (1814, 'Mineral Conchology,' i. p. 153) as "an equilateral unequal-valved bivalve with a reflexed, more or less cylindrical, margin; hinge transverse, linear; beak imperforate; one valve convex, the other flat or concave externally." He also adds:—"His [Martin's] Conch. *Anomites productus* is a good type of the Genus, therefore, as the name *Anomites* must be laid aside, I have adopted his specific name as the Generic one, the character it expresses being also peculiar." Sowerby (*op. cit.* p. 158) renamed *Anomites productus* of Martin *Productus martini*, and describes it in 1821 (Min. Conch. iv. p. 15). Since the species *Anomites productus* (=*Productus martini*) was considered by Sowerby to be typical of his genus, it is in strict accordance with the Rules of Zoological Nomenclature to regard it as the genotype of *Productus*.

Confusion arose as Sowerby figured more than one species as *Productus martini*, and only one of these specimens is

identical with *Anomites productus*, Martin. Following de Koninck's and Davidson's lead the species *Productus martini* was regarded as either identical with or a variety of *Productus semireticulatus* (Martin), itself an ill-defined species. In consequence of this, Dall (1877, Bull. U.S. Nat. Mus. viii. p. 58) quoted *Productus martini* Sowerby = *Anomites semireticulatus* (Martin) + *A. productus*, Martin, as the genotype of *Productus*; while Hall (1893, 'Palæontology New York,' viii. p. 325) quoted *P. martini*, Sowerby = *Anomites productus*, Martin = *A. semireticulatus*, Martin = *Productus semireticulatus* as the genotype. Later (1894, Eleventh Annual Report State Geol. p. 297) Hall and Clarke reduced this quotation of the genotype simply to *Productus semireticulatus*.

Productus semireticulatus was, therefore, regarded as the type of the genus *Productus* until I. Thomas (1914, Mem. Geol. Surv. Gt. Brit. Palæont. i. pt. 4, p. 258) quoted *P. productus* as the genotype. This was adopted by Chao in 1927 (Pal. Sinica, B. v. fasc. 2, p. 26) and by me in 1928 (Mem. Geol. Surv. Gt. Brit. Palæontology, iii. pt. 1, p. 35), when the species *P. productus* and *P. semireticulatus* were finally disentangled.

Investigation of the species *P. productus* (= *P. martini*, pars) has shown that it differs in internal structure from *P. semireticulatus* in having an extra shelly plate or diaphragm, which is developed round the anterior end of the visceral disk of the brachial valve and extends between the trails of the two valves, usually at right angles to them.

A similar shelly plate was found by Dr. Girty in the North American species, *P. elegans*, Norwood & Pratten, and this species became the type of his genus *Diaphragmus*. Since the two genera *Productus* and *Diaphragmus* are characterised by a similar internal structure, *Diaphragmus* must be regarded as a synonym of *Productus*.

Productus thus becomes limited to a small group of species, including *P. productus* (Martin), *P. concinnus*, J. Sow., *P. carbonarius*, de Koninck, *P. redesdalensis*, Muir-Wood, *P. garwoodi*, Muir-Wood, etc. A new name is required for *Productus semireticulatus* and allied species, and also for such forms as *P. longispinus* and *P. lobatus*, all of which are at present grouped under the generic name *Productus*. The name *Dictyoclostus*, gen. nov., is therefore proposed for the *semireticulatus* group with *P. semireticulatus* as genotype, and *Eomarginifera*, gen. nov., is proposed for the *longispinus* group with *P. longispinus* as genotype.

Subfamily *Productinae*, Waagen.

Productus, J. Sowerby, 1814 ('Mineral Conchology,' vol. i. p. 153), *emend.* H. M. Muir-Wood.

Genotype. *Anomites productus*, W. Martin (=*P. martini*, J. Sowerby, pars).
Syn. *Diaphragmus*, Girty (1910, Ann. N.Y. Acad. Sci. xx. pt. 2, no. 3, pp. 217, 218).

Diagnosis.—Shell elongate, both valves geniculate; hinge narrow; pedicle valve with long spreading trail. Flanks steep and posteriorly flattened. Shell costate in all growth-stages, costæ numerous, flexuous. Ribs few, seldom prominent. Spines set in rows on ears and cardinal slopes and scattered on trail. Teeth, dental sockets, and delthyrium absent. Marginal ridges narrow, short. A thin shelly plate or diaphragm developed round anterior margin of visceral disk of brachial valve, extending across space between trails of the two valves.

Species.—*Productus carbonarius*, de Kon., *P. concinnus*, J. Sow., ? *P. furcatus*, Muir-Wood *, *P. garwoodi*, Muir-Wood *, *P. elegans*, Norwood & Pratten, *P. productus* (W. Martin), *P. productus*, var. *hispidus*, Muir-Wood, *P. redesdalensis*, Muir-Wood.

Range.—*Syringothyris* zone to Upper Carboniferous.

Remarks.—This genus has not been found below the C. zone and the geologically earliest described species is *P. garwoodi*, which occurs in the C_1–S_2–D_1 sub-zones of Westmorland. This species, which was apparently developed from *P. rotundus*, Garwood, was probably the ancestor of *P. redesdalensis*, which occurs in the D_1–D_2 sub-zones of N. England and of Scotland. *P. redesdalensis* probably gave rise to *P. carbonarius*, which ranges from D_2 sub-zone up to the Upper Carboniferous. The interior of *P. furcatus* is at present unknown, and this species is doubtfully referred to the genus *Productus*. *P. concinnus* and *P. productus* were probably derived from a form resembling *P. furcatus*.

The distinguishing character of *Productus* is the diaphragm which extends across the narrow space between the trails of the two valves and closes the entrance to the visceral cavity. The diaphragm must therefore have been either porous or movable, in order to admit the passage of water into the shell.

* Ref. Muir-Wood, Mem. Geol. Surv. Gt. Brit. Palæont. i. pt. 4 (1928).

DICTYOCLOSTUS, gen. nov.

Genotype. *Anomites semireticulatus*, W. Martin (in part.), Petrificata Derbiensia, p. 7, pl. xxxii. figs. 1, 2, pl. xxxiii. fig. 4 (Wigan, 1809).
Syn. *Productus*, J. Sowerby (in part.).

Diagnosis.—Shell elongate or quadrate in outline. Hinge moderately wide; pedicle valve evenly convex or produced into a short curved trail, brachial valve concave or geniculate. Costate in all growth-stages, costæ often prominent, bearing numerous spine-bases. Spines also in rows on ears and cardinal slopes. Ribs on visceral disk numerous and forming net-like ornament by enlargement at point of intersection with costæ. Diaphragm absent. Marginal ridges prominent, extending along hinge. Hinge-teeth, sockets, and cardinal area not developed.

Species.—*Productus antiquatus*, J. Sow., *P. bristolensis*, Muir-Wood, *P. costatus*, J. de C. Sow., ? *P. flexistrius*, M'Coy, *P. griffithianus*, de Kon., *P. hindi*, Muir-Wood, and var. *wettonensis*, Muir-Wood, *P. howratensis*, Muir-Wood, *P. insculptus*, Muir-Wood, *P. kilbridensis*, Muir-Wood, *P. multispiniferus*, Muir-Wood, *P. muricatus*, Phill., *P. pinguis*, Muir-Wood, *P. projectus*, Muir-Wood, *P. pugilis*, Phill., and mut. *senilis*, Muir-Wood, *P. rotundus*, Garwood, *P. scoticus*, J. Sow., *P. semireticulatus* (Mart.), *P. sulcatus*, J. Sow., *P. teres*, Muir-Wood, *P. vaughani*, Muir-Wood.

Range.—*Zaphrentis*-zone to Permian.

Remarks.—This genus ranges throughout the British Lower Carboniferous and also occurs abundantly in the marine Upper Carboniferous of Europe and North America, as well as in the Permian.

Dictyoclostus is distinguished from *Productus* by the absence of a diaphragm, by its wider hinge, less spreading trail, more prominent and less flexuous costæ.

EOMARGINIFERA, gen. nov.

Genotype. *Productus longispinus*, J. Sowerby, Mineral Conchology, vol. i. 1814, p. 154, pl. lxviii. fig. 1.
Syn. *Productus*, J. Sowerby (in part.).

Diagnosis.—Shell small, quadrate or elongate in outline. Pedicle valve evenly convex or slightly geniculate, with cincture often separating visceral disk from trail, brachial valve concave or geniculate. Costate in all growth-stages, costæ usually fine. Ribs slightly enlarged at point of intersection with costæ. Spines few, not increasing in number in senile stage, six spines symmetrically developed. Exterior of brachial valve with lamellose thickening round

anterior and lateral margins. Interior of brachial valve with thickened shelly ridge, bearing slight crenulations, extending from cardinal process round lateral margins.

Species.—*Productus derbiensis*, Muir-Wood, *P. lobatus*, J. Sow., and var. *flexus*, var. *laqueatus*, Muir-Wood, *P. longispinus*, J. Sow., *P. minutus*, Muir-Wood, *P. præcursor*, Muir-Wood, *P. pseudoplicatilis*, Muir-Wood, *P. setosus*, Phill., *P. tissingtonensis*, Sibly, *P. triquetrus*, Muir-Wood.

Range. — Lower Carboniferous, ? C zone to Upper Carboniferous.

Remarks.—This genus is distinguished from *Productus* by the absence of a diaphragm. The symmetrical arrangement of six spines—one on each cardinal extremity, two on the front of the shell below the visceral disk, and one on the posterior part of each flank—distinguishes it from both *Productus* and *Dictyoclostus*. *Eomarginifera* is distinguished from *Marginifera* by the less-marked marginal ridges in the brachial valve and the absence of these ridges in the pedicle valve, also by the lack of crenulations on the exterior of the marginal ridges of *Eomarginifera*. The ornament and arrangement of the spines of *Eomarginifera* are also distinct from those of *Marginifera*. The latter genus is confined to the Upper Carboniferous and Permian.

Classification of the *Productinæ*.

A considerable amount of overlapping is shown in the researches of Chao, Fredericks, Sarytcheva, and Whitehouse on the subject of the classification of the Productinæ and the following pairs of genera are synonymous. It is unfortunate that Fredericks' genera are described in Russian, with only a short *résumé* in English, and that many of his genera are vaguely described:—

Sowerbina, Fredericks, 1928 (Bull. Com. Géol. Leningrad, xlvi. 7, p. 789): genotype, *P. timanicus*, Stuckenberg = *Horridonia*, Chao, 1927 (Pal. Sinica, B. v. fasc. 2, pt. 1, p. 24): genotype, *P. horridus*, J. de C. Sow. (includes also *P. timanicus*).

Ruthenia, Fredericks, 1928 (*loc. cit.* p. 789): genotype, *P. irginæ*, Stuckenberg (includes also *P. humboldti*, d'Orb., and *P. purdoni*, Dav., etc.) = *Waagenoconcha*, Chao, 1927 (*loc. cit.* p. 85): genotype, *P. humboldti*, d'Orb. (includes also *P. irginæ* and *P. purdoni*).

Cora, Fredericks, 1928 (*loc. cit.* p. 790): genotype, *P. cora*, d'Orbigny [also *Euproductus*, Whitehouse, 1928, nom. nud. (Rept. Aust. Ass. Adv. Sci. xviii. p. 281)]: genotype,

P. cora, d'Orb. = *Linoproductus*, Chao, 1927 (*loc. cit.* p. 128): genotype, *P. cora*, d'Orb.

Cancrinella, Fredericks, 1928 (*loc. cit.* p. 791): genotype, *P. cancrini*, De Vern., ? = *Linoproductus*, Chao, 1927.

Gigantella, Sarytcheva, 1928 (Mem. Geol. Sci. Res. Inst. Moscow, Geology, p. 13): genotype, *P. giganteus* (Martin) (includes also *P. edelburgensis*, Phill., and *P. latissimus*, J. Sow.) = *Kansuella*, Chao, 1928, pars (Pal. Sinica, B. v. fasc. 3, pt. 2, p. 67): genotype, *K. kansuensis*, Chao (includes also *P. giganteus* and *P. edelburgensis*).

Key to the Classification of the British Productinæ.

A. SHELL COSTATE IN ALL GROWTH-STAGES.

1. Shell ornamented by ribs and costæ on the visceral disk and anteriorly by costæ only. Costæ bifurcating, intercalations rare.
   (*a*) With diaphragm .... *Productus*, J. Sowerby, 1814, emend. Muir-Wood, 1929 (see p. 102).
   (*b*) Without diaphragm .... *Dictyoclostus*, Muir-Wood, 1929 (see p. 103).
   (*c*) Marginal ridge in interior of brachial valve. Shell small, with six spines symmetrically arranged on pedicle valve .... *Eomarginifera*, Muir-Wood, 1929 (see p. 103).
2. Shell costate and ribbed on visceral disk, costate on trail, both valves geniculate. Cardinal area in pedicle valve with delthyrium closed by deltidium ...... *Sinuatella*, Muir-Wood, [1928.
   Genotype: *P. sinuatus*, de Kon.
3. Shell convex (not geniculate), ornamented by costæ and well-marked concentric growth-lines .... *Thomasia*, Fredericks, [1928.
   Genotype: *P. margaritaceus*, Phill.
4. Shell ornamented by fine costæ and numerous intercalations, usually with broad wrinkles on lateral slopes.
   (*a*) Shell regular, quadrate, pedicle valve highly convex or geniculate .... *Linoproductus*, Chao, [1927.
   Genotype: *P. cora*, d'Orbigny; also *P. corrugatus*, M'Coy, *P. hemisphericus*, J. Sow., *P. koninckianus*, de Vern., *P. undatus*, Defrance.
   (*b*) Shell irregular or elongate-triangular, tapering to umbo, pedicle valve slightly convex.......................... *Striatifera*, Chao, 1927.
   Genotype: *P. striatus* (Fischer de Waldheim).
   (*c*) Pedicle valve cylindrical, brachial valve operculiform .... *Proboscidella*, Oehlert, [1887.
   Genotype: *P. proboscideus* de Vern.; also *P. ermineus*, de Kon.

5. Shell large, massive, hinge long. Costæ fine, irregular. Ribs developed posteriorly.
   (*a*) Cardinal area rarely developed on pedicle valve. .... *Gigantella*, Sarytcheva, [1928.
   Genotype: *P. giganteus* (Martin); also *P. latissimus*, J. Sow., *P. maximus*, M'Coy, *P. edelburgensis*, Phill.
   (*b*) Cardinal area developed in both valves, delthyrium closed by deltidium in pedicle valve .... *Kansuella*, Chao, 1928, emend. H. Muir-Wood, 1929.
   Genotype: *K. kansuensis*, Chao. Probably includes certain undescribed British species.

B. Shell spinose in all growth-stages.

6. Shell ornamented by numerous scattered spine-bases which are anteriorly elongated. Ribs faintly developed on cardinal slopes .... *Krotovia*, Fredericks, [1928.
   Genotype: *P. spinulosus* (Martin); also *P. aculeatus* (Martin).
7. Shell ornamented by elongated spine-bases and concentric ribs.................... *Pustula*, I. Thomas, [1914.
   Genotype: *Productus pustulosus*, Phill.; also *Pustula distorta*, Thomas, *P. interrupta*, Thomas, *P. magnituberculata*, Thomas, *P. nodosa*, Thomas, *Pr. ovalis*, Phill., *P. pilosa*, Thomas, *Pr. pyxidiformis*, de Kon., *Pr. rugatus*, Phill., *P. subpustulosa*, Thomas, *P. tenuipustulosa*, Thomas.
8. Shell ornamented by broad concentric bands bearing rows of spine-bases .... *Echinoconchus*, Weller, [1914.
   Genotype: *Productus punctatus* (Martin); also *P. elegans*, M'Coy, *Pustula subelegans*, Thomas, *P. venusta*, Thomas, *P. defensa*, Thomas, *P. exquisita*, Thomas, *P. eximia*, Thomas.
9. Shell ornamented by concentric bands bearing one row of spine-bases. Brachial impressions spoon-shaped .... *Overtonia*, Thomas, [1914.
   Genotype: *P. fimbriatus*, J. de C. Sow.

C. Shell spinose and costate.

10. Shell ornamented by spines posteriorly and costæ anteriorly .... *Avonia*, Thomas, emend. [Muir-Wood, 1928.
    Genotype: *P. youngianus*, Dav.; also *P. bassus*, Vaughan, *P. davidsoni*, Jaross, *P. keyserlingianus*, de Kon.

D. Shell costate, ribbed, and spinose.

11. Shell ornamented posteriorly by ribs and by costæ bearing elongated spine-bases, and anteriorly by flattened bands bearing

rows of spine-bases. Median septum posteriorly bifurcating .... *Buxtonia*, Thomas, 1914, emend. Muir-Wood, 1928.
Genotype: *P. scabriculus* (Martin), also *P. scabriculo-costatus*, Vaughan.

E. Shell ribbed.

12. Shell ornamented by prominent concentric ribs. Anterior margin surrounded by ribbed rim projecting at right angles to shell............................ *Thomasella*, Fredericks, [1928.
Genotype: *P. wrighti*, Dav.
13. Shell ornamented by concentric ribs, and attached by cementation or by spines along hinge of pedicle valve .... *Etheridgina*, Oehlert, [1887.
Genotype: *P. complectens*, Etheridge.
14. Shell ornamented by ribs and large scattered spines .... *Plicatifera*, Chao, 1927.
Genotype: *P. plicatilis*, J. de C. Sow.; also *P mesolobus*, Phill., ? *P. carringtonianus*, Dav.

F. Shell smooth.

15. Shell ornamented by large spines and growth-lines, and rarely by faint traces of costation .... *Horridonia*, Chao, 1927.
Genotype: *P. horridus*, J. de C. Sow.

The precise range of many of these genera is uncertain. *Horridonia* is apparently limited to the Permian. *Thomasia* and *Thomasella* occur in the Upper *Dibunophyllum*-zone, but may range upwards. *Kansuella* is possibly confined to the Lower Carboniferous, and occurs in the *Dibunophyllum*-zone. *Gigantella* and *Striatifera* are not known below the *Seminula*-zone, and are especially characteristic of the Upper *Dibunophyllum*-zone, but they extend up into the Upper Carboniferous or even into the Permian. *Productus*, *Linoproductus*, *Plicatifera*, and *Eomarginifera* were probably evolved in Upper *Zaphrentis* or Lower *Syringothyris* times, but became more abundant in D_2. *Linoproductus* and *Productus* extend up to the Upper Carboniferous. *Buxtonia*, *Pustula*, *Echinoconchus*, *Avonia*, and *Dictyoclostus* appear in the *Cleistopora*-zone or early *Zaphrentis* times, and range throughout the Carboniferous.

References.

Chao, Y. T. 1927. "Productidæ of China.—Part I." Pal. Sinica, Peking, ser. B, vol. v. fasc. 2.
——. 1928. "Productidæ of China.—Part II." *Op. cit.* vol. v. fasc. 3.
Fredericks, G. 1928. "Contribution to the Classification of the Genus *Productus*." Bull. Com. Geol. Leningrad, vol. xlvi, 7.
Girty, G. H. 1910. Ann. N. York. Acad. Sci. vol. xx. no. 3, pt. 2.

Muir-Wood, H. M. 1928. "The British Carboniferous Producti.—II." Mem. Geol. Surv. Gt. Brit. Palæont. vol. iii. pt. 1.
Oehlert, D. P. 1887. "Brachiopodes" in Fischer, P. H., 'Manuel de Conchyliologie,' Paris.
Sarytcheva, T. G. 1928. "The Productidæ of the Group *Prod. giganteus*, Mart., from the Visean of Moscow." Mem. Geol. Sci. Res. Inst. Moscow, 1928.
Thomas, I. 1914. "The British Carboniferous Producti.—I." Mem. Geol. Surv. Gt. Brit. Palæont. vol. i. pt. 4.
Weller, S. 1914. "The Mississippian Brachiopoda of the Mississippi Valley Basin." Illinois State Geol. Surv. Rep. i.

(For more complete lists, see Muir-Wood and Thomas.)

VIII.—*Descriptions and Records of Bees.*—CXXI. By T. D. A. Cockerell, University of Colorado.

Andrena kuznetzovi, sp. n.

♀ (type).—Length 13·7 to 14·7 mm.

Head, thorax, and legs black; abdomen shining green, the depressed parts of the tergites bluish green, the first tergite purplish black except apically, the second suffused with purplish black across the middle, the third to fifth with the elevated part yellowish green; hair of head and thorax long and thin, rather dull white, black at apex of clypeus, on vertex, across middle of thorax, between wings (but thin), and on legs, but anterior femora with long white hair behind, middle femora with some white hair above, hind femora with a white fringe in front, and the large curled floccus pure white; abdomen without bands, caudal fimbria greyish black, with long white hairs overlapping and at sides; facial quadrangle broader than long, very long white hair at sides of face; malar space linear, but evident; mandibles ordinary; process of labrum very broad, rounded; clypeus finely and densely rugoso-punctate, but glistening, with a delicate median raised line; front striate; flagellum dusky reddish beneath, except at base; third antennal joint long, exceeding next two together; facial foveæ dark chocolate-brown, moderately broad, running close to orbits, and ending much below level of antennæ; mesothorax dull and minutely granular, except the posterior middle, which is shining and sparsely punctured; scutellum bigibbous, the elevations shining, the surface much more closely punctured than posterior part of mesothorax, but on each side a little space with few punctures; area of metathorax triangular, poorly defined, minutely rugulose, with feeble irregular plications (hardly

evident under lens) at base; mesopleura dullish; tegulæ black. Wings long, hyaline, the upper portion and apex suffused with pale brown; basal nervure meeting nervulus; second cubital cell very broad, receiving recurrent nervure slightly or considerably beyond middle; third cubital shorter than usual; spurs black; second tergite depressed in middle about a third. Surface of abdomen under microscope minutely tessellate, with sparse, very minute, piliferous punctures; under a lens the abdomen appears impunctate.

♂.—Length about 12 mm.

With the usual sexual differences; face very broad; mandibles long but stout, with an inner tooth; face with long pure white hair, but much black at sides; flagellum long, dark brown beneath; third antennal joint not as long as next two together, the fifth being unusually long; thorax with long white hair, black on disc of scutellum; stigma narrow, red with a dark margin; abdomen shining steel-blue.

Tashkent, Usbekistan, March 25, 1926; many females and two males (*N. Kuznetzov*).

A fine species of the group of *A. cineraria*, L., in the Central Asian fauna to be compared with *A. metallescens*, Ckll., from Tamerlan-Kuporjuk, which has the caudal fimbria fulvous, and with *A. peregrina* (Smith), from Yangihissar, which has the wings with a deep fuliginous cloud and the female abdomen dark purple.

There is some general resemblance to *A. ferghanica*, Mor., which is rather large, with the hair on the thorax grey. The male has the abdomen much more polished than in *A. cineraria* (L.).

Andrena kuznetzovi, form *micrander*, nov.

On the same day and also on March 21 Prof. Kuznetzov took numerous males, 9 to 9·5 mm. long. I set these aside as a different species, but they have no valid characters, and I find the genitalia of the large and small males to be exactly alike. It is thus evident that the male of this species is sharply dimorphic as to size.

Andrena brevipalpis, sp. n.

♀.—Length about or hardly 10 mm., anterior wing 7.

Black, rather slender; head and thorax with erect hair, fulvous dorsally, pale greyish on face, cheeks, and pleura; facial quadrangle about square; malar space linear; mandibles ordinary; process of labrum broadly truncate; clypeus thinly hairy, shining, but with a minutely tessellate

surface, with widely scattered large punctures, the middle line impunctate but not elevated or polished; front striate; third antennal joint slightly longer than next two together; flagellum ferruginous beneath except at base; facial foveæ moderately broad, pale clear ochreous, close to orbits, extending below level of antennæ; mesothorax dullish, but shining on disc, the surface minutely tessellated and rather sparsely (hardly noticeably under lens) punctured; scutellum shining; area of metathorax poorly defined, entirely dull and rugulose, without plicæ; lower part of mesopleura somewhat shining; tegulæ rufo-fulvous. Wings hyaline, slightly dusky; stigma not very large, pale fulvous with dark margin, nervures pale fuscous; basal nervure falling short of nervulus; second cubital cell rather small, a little higher than long, receiving recurrent nervure at about the end of the third fifth. Legs black, with pale hair, light rufo-fulvous on inner side of tarsi; tibial scopa ample and rather loose, very pale fulvous, the hairs on outer side simple; claws bifid; scopa of hind femora very long and white. Abdomen moderately shining, dull in some lights, so finely punctured as to appear practically impunctate under a lens; second tergite in middle depressed less than half but more than a third; tergites 2 to 4 with narrow, dense, very pale ochreous hair-bands, broadly interrupted on second; caudal fimbria dark brown.

Boulder, Colorado; one ♀ captured on the window of my office at the University of Colorado, June 26, 1929.

It has almost exactly the aspect of *Iomelissa violæ*, Rob., and looked at from behind could be supposed identical; but the face is much narrower and the palpi are short, whereas in *Iomelissa* they are much elongated. In Viereck's Connecticut table it runs to *A. novæangliæ*, Vier., but it is not that.

Andrena basifusca, sp. n.

♀.—Length about 12 mm.

Robust; head, thorax, and legs black, abdomen dark purple-blue; first tergite mainly black, with apical margin blue; second shining black, with the depressed part brilliant purple; third and fourth purple, blue along the margins of the depression; fifth blue, with apical fimbria black; sides of face with long white hair, vertex and cheeks with black hair; thorax anteriorly and posteriorly with white hair, but black between the wings; sides of thorax with black hair, but white on tubercles, and upper part of mesopleura with some long white hairs. Abdomen bare. Legs with black hair, long white

hairs on anterior femora behind, and basal floccus of hind legs white; facial quadrangle broader than long; malar space linear; clypeus glistening but not polished, closely punctured, with a strong median ridge; flagellum very obscurely brownish beneath; third antennal joint longer than the next two together; foveæ not very broad, dark brown, separated from eye by a wide shining band; mesothorax and scutellum densely punctured but glistening; mesothorax polished posteriorly, but scutellum hardly so anywhere; area of metathorax triangular, rugulose, with feeble plicæ at base; tegulæ black, a little reddish posteriorly. Anterior wings deep fuliginous, violaceous, the brown colour extending to base; basal nervure meeting nervulus; second cubital cell very broad, receiving recurrent nervure beyond middle; stigma small and black; second tergite in middle depressed more than a third but less than half. Abdomen shining, without evident punctures.

Ak-Tasch Mountains, Usbekistan, June 19, 1926 (*N. Kuznetzov*).

Very like *A. peregrina* (Smith), but easily distinguished by the wings not being hyaline at base.

Also resembles *A. hemicyanea*, Ckll., but the wings not longitudinally bicoloured, and clypeus different. It may also be compared with *A. fumipennis*, Schm., but that has a quite different clypeus and wings not so dark.

Andrena zachroa, sp. n.

♀.—Length about 11·2 mm.

Head and thorax black, with stiff very rich ferruginous-red hair, dense on sides of face and about antennæ, on sides of mesothorax and scutellum, and on postscutellum, but very sparse on clypeus and discs of mesothorax and scutellum; malar space linear; mandibles very faintly reddened about middle; labrum black, the process truncate; antennæ black, third joint nearly as long as next two combined; clypeus flattened, dull, minutely and densely punctured, with a delicate median raised line; facial foveæ broad, but very inconspicuous, largely overlapped by the spreading red hair; cheeks shining; mesothorax dull, slightly shining, very finely and closely punctured, microscopically tessellate between the punctures; posteriorly the mesothorax is more shining, and the scutellum is shining; area of metathorax entirely dull and granular, without plicæ, and defined only by absence of hair; mesopleura dull; tegulæ shining dark red. Wings strongly reddened; stigma moderate, dull ferruginous, with darker

margin; nervures fuscous; basal nervure going basad of nervulus; second cubital cell about square, receiving recurrent nervure a little beyond middle; third cubital long. Legs black, with anterior tibiæ apically, and their tarsi, middle femora apically, and their tibiæ and tarsi, and hind femora, tibiæ, and tarsi all red; scopa of hind legs bright red; spurs red; middle basitarsi broad. Abdomen flattish, mostly bare, moderately shining, reddish black, with the first tergite, sides of second, and transverse suffusion on third and fourth rather dark red; a large black spot at each extreme side of second; apices of segments 2 to 4 with broad, dense, very bright orange-fulvous hair-bands, very widely interrupted on 2, narrowly on 3, entire on 4; apical tuft red; venter black, with red hair-bands.

Tunis; no other data available.

One of the most beautiful species of the genus. It resembles *A. cirtana*, Lucas, which I saw in Mr. Morice's collection, and noted; very handsome shining red abdomen, first tergite black with red hind margin; hair of head and thorax entirely bright red. There is also a strong resemblance to *A. russula*, Lep., judging from the description, but that has the abdomen black, with the band on the fourth tergite interrupted. The length is given as 4½ lines, which appears too small; but *A. oraniensis*, Lep., is said to be 4 lines, and it is actually over 12 mm. long. It is possible that the present insect is a rufescent variety of *A. russula*.

Andrena melandura, Cockerell, 1922.

Andrena æmula, Alfken, 1926, is a synonym.

Andrena hemicyanea, sp. n.

♀.—Length about 13 mm., anterior wing 10·5.

Robust; head, thorax, and legs black; abdomen dorsally deep blue, shining, but the venter brownish black; head broad, facial quadrangle nearly square; mandibles black, malar space linear; sides of face with long, outstanding, very conspicuous white hair; occiput and upper part of cheeks with long white hair; lower part of cheeks, sides of vertex, and clypeus with black hair, on clypeus thin and not conspicuous; clypeus very densely and strongly punctured, glistening between the punctures, and with a strong shining median keel; process of labrum shining, broadly rounded, with sloping sides; facial foveæ dark chocolate-brown, moderately broad, going below level of antennæ, with only a linear separation from orbits; antennæ black, third joint very

long, about equal to next two combined; thorax practically hairless above, tubercles conspicuously tufted with white hair; sides of metathorax with much white hair, forming a scopa; pleura very coarsely rugoso-punctate, with thin black hair; mesothorax shining, with scattered distinct punctures; scutellum similarly sculptured, the punctures very sparse on disc; postscutellum coarsely punctured, not hairy; area of metathorax large, dull, with coarse wrinkles, and defined by a rounded line (not at all squared off behind); tegulæ black. Anterior wings with the upper half deep fuliginous, violaceous, the lower portion and a space just beyond third discoidal cell hyaline; stigma narrow, reddish, with dark margin; nervures dark fuscous; basal nervure going well basad of nervulus; second cubital cell broad, receiving recurrent nervure a little beyond middle; third cubital about as broad on marginal as second. Legs with mainly black hair, but much white on anterior femora behind, on hind femora beneath, and scopa of hind tibiæ outwardly white; hair on inner side of hind basitarsi purplish black; spurs black. Abdomen broad, shining, practically hairless above, but with a dense black caudal tuft, the sides of fifth tergite with much white hair and of fourth with white tufts; surface of tergites polished, feebly punctured; second tergite in middle depressed less, but not much less, than one-half.

Tunis; no other data available.

Closely related to *A. agilissima* (Scopoli), for which it might be taken, but a little smaller, the raised part of second tergite less closely and evenly punctured; area of metathorax shorter and broader, more semicircular; mesothorax more shining and less closely punctured; third cubital cell more produced apically. *A. asperrima*, Pérez, departs from the *A. agilissima* type in the opposite direction.

Andrena kengracensis, sp. n.

♀.—Length 11·2 mm.

I had referred this to *A. flavipes* (Panzer), which is recorded from this region, and no doubt it has been so regarded. In the Tashkent Museum I saw a specimen from Tashkent labelled "*A. fulvicrus*, Kirby (=*flavipes*)," but whether it was *A. kengracensis* I cannot now say. On comparison with *A. flavipes* from Gray, France (*André*), the new species differs by the dull white hair of under surface of thorax and sides of face, which should refer it to *A. gravida*, Imh.; but it differs from *gravida* (from Hastings, *Sladen*) by the shorter hind basitarsi, with the hair on the inner side dark chocolate instead of lively pale reddish. The third antennal

joint is much longer than the next two together, the fourth being short and transverse. In *A. gravida* the fourth joint is longer. The three abdominal bands of *A. kengracensis* are pure white, instead of having a pale ochreous tint as in *A. flavipes.* Thus, while the insect runs to *A. gravida* in the tables, it is, on the whole, a closer relative of *A. flavipes,* perhaps best regarded as a subspecies. The type-locality is Kengrak hills, 26–28 kilometres north of Tashkent, Usbekistan, in a stony desert, May 16, 1926, 4 ♀ (*N. Kuznetzov*). Also one from Ak-Tasch mountains, about 1250–1600 metres above sea-level, June 22, 1926 (*Kuznetzov*).

Andrena (*Ptilandrena*) *pronitens*, sp. n.

♀.—Length about 8 mm.

Black, with the small joints of the tarsi reddish; hair of head and thorax erect and abundant, pale ferruginous dorsally, long and bright on scutellum; hair of face (very thin), cheeks, and underside of thorax dull whitish; malar space very short; mandibles ordinary, very faintly rufescent subapically; process of labrum elevated, broadly truncate; clypeus strongly convex, highly polished and impunctate on disc, dull at extreme sides; front striate; facial quadrangle broader than long; antennæ black, third joint not very long, but as long as next two together, or nearly so; facial foveæ rather broad, pale brown, very conspicuous, ending below at level of antennæ, with only a linear separation from orbits; mesothorax dull, scutellum shining, mesopleura dull; area of metathorax large, triangular, dull, with very short plicæ (between which the surface is somewhat shining) at extreme base; tegulæ dark brown. Wings reddish hyaline, apically greyish; stigma large, clear ferruginous, approaching orange; nervures pale ferruginous; basal nervure falling short of nervulus; second cubital cell narrow, receiving recurrent nervure at beginning of its last third. Legs with pale fulvous hair, the tibial scopa very pale, not dense, on outer side with strongly plumose (pectinate) hairs, the branches not numerous. Abdomen rather broad, dullish, appearing impunctate, the microscope showing a minutely tessellate surface with excessively minute scattered punctures; second tergite in middle depressed less than a third; tergites 2 to 4 with narrow greyish-white hair-bands, very thin in middle of second; apex with very pale grey hair.

Geneva Park, Boulder, Colorado, May 14, 1929 (*Hugo Rodeck*).

Resembles *A. beckeri*, Ckll., but easily distinguished by the clypeus. There is, perhaps, little real affinity, as in *A. beckeri* the hairs on outer side of hind tibiæ are simple.

Another species with shining clypeus, taken at Boulder, is *A. flavoclypeata*, Smith. Robertson places this in his genus *Opandrena*, but actually the hair on outer side of hind tibia in the female is plumose.

Mr. Rodeck also took at Boulder *A. nasoni hartfordensis* (Ckll.), new to Colorado.

At Rifle, Colorado, Mr. S. A. Rohwer took *A. sapellonis*, Ckll., also new to Colorado.

Andrena azalearum, sp. n.

♀.—Length about 12 mm.

Not unusually robust; black, including mandibles, antennæ, tegulæ, and legs; hair of head and thorax white, but black on vertex, sides of face above, posterior part of mesothorax, and scutellum; legs with mainly white hair, pale ferruginous on inner side of tarsi, scopa of hind tibiæ bicoloured, white in front, black behind; abdomen dorsally bare, a little pale hair at sides, caudal fimbria black, ventral segments fringed with long glistening white hairs; facial quadrangle broader than long; malar space linear but evident; mandibles ordinary; clypeus convex, shining, distinctly and rather closely punctured, with no median ridge; process of labrum narrowly truncate; third antennal joint not specially long, but about equal to next two together; facial foveæ broad, entirely dark, separated from eye by a rather wide band, which, however, is not shining; mesothorax dull anteriorly, posteriorly polished, with scattered rather small punctures; scutellum shining; area of metathorax poorly defined, triangular, entirely dull, weakly plicatulate at base; mesopleura moderately glistening. Wings long, brownish hyaline, more dusky at apex; stigma moderate, black; nervures dark fuscous; basal nervure meeting nervulus; second cubital cell broad, receiving recurrent nervure about middle; spurs light reddish. Abdomen shining, very finely but distinctly punctured; second tergite in middle depressed much more than a third but less than a half.

Japan, near Tokyo; on *Azalea*, May 13, 1929 (*Dorsett and Morse*). U.S. National Museum.

A very distinct species, which runs out in my table of Japanese *Andrena* (Ann. & Mag. Nat. Hist., Feb. 1913) next to *A. watasei*, Ckll.

Nomia semiaurea thor, subsp. n.

♀.—Tegument of legs entirely black.

♂.—Described in "Bees.—CXVII.," p. 137.

Thursday Island, March 15 (*Cockerell*).

IX.—*Some Remarks on* Dictyoconoides, *Nuttall* (=Conulites, *Carter* =Rotalia, *Lamarck*). By C. van Rijsinge, The Hague, Holland.

[Plates V. & VI.]

In 1861 H. J. Carter created for some conical fossil Foraminifera the new genus *Conulites*, of which he described one species: *Conulites cooki* (H. J. Carter, "On Fossil Foraminifera of Scinde," Ann. & Mag. Nat. Hist. ser. 3, vol. viii. 1861, pp. 331–332, and pp. 457–458, pl. xv. figs. 7 *a–g*).

The next year W. B. Carpenter, having examined the new-described forms, came to the conclusion that he could best unite this genus and *Orbitolina*, d'Orbigny, with the genus *Patellina*, Williamson, and hence in his 'Introduction' the fossil appeared under the name *Patellina cooki* (W. B. Carpenter, W. K. Parker, and T. R. Jones, 'Introduction to the Study of Foraminifera,' 1862, pp. 233–234, text-fig. xxxviii. *a–g*).

In 1905 H. Douvillé and Ch. Schlumberger referred briefly at the end of a publication on *Dictyoconus* and *Lituonella* to the genus *Conulites*, Carter, stating:—"Il résulte en tout cas de ces indications que ce genre appartient aux Perforés" (H. Douvillé and Ch. Schlumberger, "Sur deux foraminifères éocènes," Bull. de la Soc. géol. de France, ser. 4, pt. v. 1905, p. 304).

This is a most important remark, that apparently has been overlooked, as we find the genus *Dictyoconoides* placed by Cushman in his last classification in the family of the Orbitolinidæ, which contains only imperforate forms, with mostly arenaceous tests.

There are not many studies of the subject until the publication of W. L. F. Nuttall in 1925 *; they are of no importance, or maybe I have overlooked them.

The name *Conulites* according to his investigations being preoccupied, he proposes the name *Dictyoconoides*, as externally Carter's *Conulites* is somewhat like *Dictyoconus*.

He states that the fossil, described by Carter as *Conulites*, cannot be arranged in the group of *Patellina*, as Carpenter did, for the following reasons:—

1. There being no segmental arrangement of the chambers.

* W. L. F. Nuttall, "Two Species of Eocene Foraminifera from India," Ann. & Mag. Nat. Hist. ser. 9, vol. xvi. 1925, p. 370.

2. The genus *Patellina* not having, in its original description, the internal pillar-structure, which is one of the peculiar characteristics of *Dictyoconoides.*
3. *Patellina* being much smaller than the now-called *Dictyoconoides* *.

The only resemblance is the conical shape, but it is really impossible to consider this as a proof of the relation between these forms, since a conical outline is found also in other Foraminifera and may be regarded as an adaptation to the life-circumstances of the animal.

There are also marked differences between *Dictyoconus* and *Dictyoconoides* :—

1. *Dictyoconus* being arenaceous, while *Dictyoconoides* is calcareous.
2. *Dictyoconus* having a subepidermical reticulate structure.
3. The central part (umbilicus) of *Dictyoconus* being filled up with chambers and not with pillars, as is the case in *Dictyoconoides.*

Thirdly, Nuttall demonstrates the difference between *Dictyoconoides* and *Orbitolina* :—

1. *Orbitolina* being arenaceous.
2. The chamber-arrangement of *Orbitolina* being cyclical and not spiral.

Supposing that the description given by Carter is not complete, Nuttall gives another description of *Dictyoconoides cooki,* from which it may be well to refer to some points.

A remarkable fact is that all the tests examined by Nuttall happened to be microspherical. The septal partitions between the chambers were double, just as is the case in *Nummulites*; they showed canals, whose further extensions, however, could not be traced. Seen on a transverse slide the chambers open at the ventral side towards the umbilicus. These internal openings "represent cells, which are divided by horizontal partitions."

Vertically these "cells" are divided by columns, which radiate first from the apex, later on from the whorl-walls. They show fine longitudinal striations. They do not enlarge

* Hofker tells me that he has discovered in *Patellina* the typical inner characteristics of *Rotalia.* Publication of these views will follow soon. As I also, as will be shown, could trace the close relation of *Dictyoconoides* to *Rotalia,* it was after all not so wrong to consider those two genera as a single genus.

near the end. Nuttall states that there is not a trace of a lateral communication between the chambers.

H. Douvillé published in 1926 : "La Forme conique chez les Foraminifères et le genre *Dictyoconoides*, Nuttall" (Bull. de la Soc. géol. de France, ser. 4, part xxvi. 1926).

In this study Douvillé refers to the conical shape as being a result of the surroundings of the individual, the quantities of food, and a pre-existing deformation of the initial chamber. He also mentions the intercalary spirals, which he supposes are formed when the last chamber before the bifurcation has two apertures instead of one. The columns bear at more or less regular distances apophyses, which correspond with the periods of growth of the organism.

The lacunæ thus remaining between those columns and apophysis must—according to Douvillé—have been filled up with protoplasm and are connected by means of lateral openings with the interior of the chambers in the whorl.

The walls of the test are finely porous, which is—as Douvillé emphatically declares—different from *Dictyoconus* and *Orbitolina*, these genera having an arenaceous test.

The same year (1926) brings also an elaborate study by L. M. Davies: "Remarks on Carter's Genus *Conulites* (=*Dictyoconoides*, Nuttall), with Description of some new Species from the Eocene of North-west India" ('Records of the Geological Survey of India,' vol. lix, part 2, p. 237).

He recalls that Wynne (Mem. Geol. Survey of India, vol. xi. part 2, p. 139) described some Rotalinæ from the Eocene, between which—as he thinks—this *Dictyoconoides* can also be found.

Yet Davies is here referring to *Conulites* and maintains this name in his article for the new species there described. I believe, however, that it is not right to keep the name *Conulites* for these Foraminifera, the name being used too much for other organisms.

So I think it best to replace this name by the name *Dictyoconoides*, Nuttall *.

Now Davies describes *Conulites kohaticus*, and here he states that he could not clearly distinguish the embryonic chamber, and thus was unable to state dimorphism.

He mentions *D. kohaticus*, var. *spintangiensis*, a flatter, somewhat larger, and more heavily built variety, *D. kohaticus*, var. *blanfordi*, a more conical form, *D. vredenburgi*, a rather

* As I will show later, I consider *Dictyoconoides* to be a typical *Rotalia*. To prevent confusion, I thought it better to retain in this article the name *Dictyoconoides*.

small form, with relatively large chambers, and *D. tipperi*, a little globular Foraminifer, with enormous chambers.

In 1928 appeared a study of H. Douvillé, wherein he suggested that the genus is referable to the same family as *Calcarina* (Séances de la Soc. Géol. de France, Compte rendu sommaire de 2 avril 1928, p. 94).

As I have not been able to obtain this article, I am sorry I am unable to refer its contents.

The study of *Dictyoconoides* had progressed so far when in two letters L. M. Davies questioned J. Hofker about the problem and also sent some material.

Dr. Hofker kindly transferred the material to me, who am at present studying Foraminifera in his laboratory. I wish to express here my special thanks to him for his calling my attention to these interesting fossils, and also for the kind and valuable advice he gave me during the study of *Dictyoconoides*.

To complete my study of the literature I may append here the ideas of L. M. Davies expressed in his letters of 30 April and 24 June of 1928, just mentioned.

Here Davies calls the type rotaliform, but states that there is some conformity with the Nummulites and Orbitoids :—

1. The presence of pillars.
2. Traces of a supra-cortical skin that can be found on the upper surface.
3. The spiral, which may be left- as well as right-handed, this being in his estimation an indication of bilateral symmetrical inclination.

However, there is some difference :—

In Nummulites: there being no marginal cord.
In Orbitoids: the spiral arrangement of the chambers, as they are arranged cyclically in the Orbitoid species.

The septa seem to be perforated at the base and the chambers open in the umbilicus.

In his second letter he refers to the above-mentioned study of H. Douvillé (1928) and sets out the differences from *Calcarina* according to him :—

1. The typical spines of this genus are never found in *Dictyoconoides*.
2. The pores of *Dictyoconoides* are finer than those of *Calcarina* and never coalesce.

3. In *Calcarina* there are never the intercalary spirals which are so common in *Dictyoconoides*.
4. The communication between the chambers of *Dictyoconoides* is formed by one single large perforation.

Dictyoconoides has so far been found only in the Lower and Middle Eocene of North-west India, the Eocene of South Arabia, the Middle Eocene of Northern Somaliland.

Finally, Davies remarks: "I am struck by the apparent bilateral characters of this genus, as well as by its apparent affiliations to *Rotalia*."

In short, with respect to the relationships of *Dictyoconoides*, we must decide between *Rotalia, Calcarina, Nummulites, Orbitoides*, and *Orbitolina*, these names being already mentioned in literature, or perhaps establish quite another relationship.

It is possible to divide the above-mentioned Foraminifera into two groups. As the Calcarines, Nummulites, and Rotalids are more closely allied, they can be separated from the Orbitolines, which are in no respect related to the first-mentioned three groups, and the Orbitoids, which also are not so closely allied to the first three.

In the most modern work on the classification of Foraminifera (J. A. Cushman, "Foraminifera, their Classification and Economic Use," Cushman Laboratory for Foram. Research, Special Publication No. 1, Sharon, Mass., 1928, p. 178) the family Orbitolinidæ is said to have the following characteristics:—"Test usually conical; early chambers spiral, later ones annular, subdivided into chamberlets, the central portion of the test with irregular chambers; wall finely arenaceous, siliceous, or calcareous; apertures on basal side of the test multiple in higher forms."

As will be shown, there are really great differences between the hitherto-known species of *Dictyoconoides* and the definition of the family Orbitolinidæ just given.

There is no question about the whorl of chambers in later periods of life becoming cyclically arranged, nor can anything be found that indicates a subdivision of the later chambers into chamberlets. Also, it is wrong to suppose the inner structure of the test to be built up by irregular chambers. As Douvillé (H. Douvillé, *l. c.* 1926, p. 25) has already declared, the walls of the test are finely porous, which indeed marks a great difference from the imperforate family of Orbitolines. Nor can it be denied that there are *not* many apertures on the basal side of the test. Probably

Cushman means the openings of the umbilical canal-system at the basal side, when referring to "apertures."

Thus it will be clear that *Dictyoconoides*, having only its systematically unimportant conical shape in common with the Orbitolines, must be removed from this family.

The differences did not remain unobserved by Cushman, who declared in his work cited above (J. A. Cushman, *l. c.* 1928, p. 184):—"*Dictyoconoides* is a very peculiar form, and probably has its affinities with the Rotalidæ or related families, but is left here until more is known of its relationships."

The Orbitoididæ are as yet not a quite logically arranged family, systematically speaking, as Wayland Vaughan points out in Cushman's "Classification" (J. A. Cushman, *l.c.* 1928, p. 335). This definition of the family is as follows:—

"Test thin or inflated, round lenticular, selliform or stellate, with a layer of equatorial chambers, which in the megalospheric generation begins growth from a multilocular embryonic apparatus. Chamber-walls perforate, usually also communication between chambers through openings for the passage of protoplasmatic stolons. *There is no canal-system.*"

As published sections and my own preparations show, there is no question about the growth from a "multilocular embryonic apparatus." Also the chambers are not equatorially arranged. Finally, of great importance is the absence of a canal-system in Orbitoids, as a canal-system is markedly and typically developed in *Dictyoconoides* and places it near the rotaliform Foraminifera. Coming now to Rotaliidæ, Calcarinidæ, and Nummulitidæ, it is perhaps best to give an account of the characteristics, place, and composition of these families.

It is a remarkable fact that, until now, most of the characters used for the limitation of families, genera, and species are taken from the general habitus of the animals. Nor can it be gainsaid, that, so long as, by a deeper study, important differences in internal structure are not known, one has a right to describe the very same forms by the same name, and, on the other hand, forms in shape widely apart by different generic and family names.

However, there can be found many evidences in foraminiferal literature that the outer shape is not a safe guide for the determination of relationships.

So we may perhaps as well, or better, turn our attention to the internal structure of the Foraminifera. As an account of this subject will fully agree with the views of Hofker,

I might perhaps refer to his work on the 'Siboga' Foraminifera (J. Hofker, "The Foraminifera of the 'Siboga' Expedition," Monograph iv. of 'Uitkomsten op Zoologisch, Botanisch, Oceanographisch en Geologisch Gebied, verzameld in Nederlandsch Oost Indie,' 1899–1900 aan boord van Hr. Ms. 'Siboga.' Edited by Dr. Max Weber, Leiden 1927, part i.) and his study on the Nummulitidæ (J. Höfker, "De Nummulitidæ," Tijdschrift Nederl. Dierk. Vereeniging, (2) part xx. 1927, p. 3), but as the first may not be so easily obtained and the second is written in a little-known language, it will not be superfluous to set out the contents here.

It is possible to distinguish two groups in the genera which so far have been assigned to the family Rotaliidæ when studying the inner structure: one group possessing a remarkable and typical canal-system and one group lacking it. As far as known now, Rotalia alone shows this system.

The family of the Calcarinidæ also shows this characteristic. There are the genera *Calcarina*, *Baculogypsina*, *Arnaudiella*, and *Patellispira*, which have a typical Rotalid canal-system, and so all the genera of this family may be regarded as a more or less distinct subfamily in the family Rotaliidæ.

To this family now can also be added the subfamily of the Polystomellidæ, generally considered as a part of the Nummulitidæ.

The Nummulitidæ, too, show a canal system that, though it may possess many resemblances to that of the Rotaliidæ, is distinctly different from it.

The canal-system of the Rotalid forms mentioned above consists of a typical spiral canal, running close under the whorl of chambers. From it spring interseptal canals, which may be simple in lower forms, but in the highest development in their turn give off little branches and in the end open with bifurcations at the dorsal suture of the shell (*cf.* the description of *Dictyoconoides kohaticus*). The spiral canal itself continues to run under the chamber-whorl, and finally opens at the umbilical margin of the last chamber. The chambers show a prolongation towards the ventral side, which in *Rotalia polystomelloides* is prolonged into the septal wall and on the other side opens in the spiral canal (J. Hofker, "Foraminifera of the 'Siboga' Expedition," part i. 1927, p. 35, pl. xvi. figs. 2, 4, and 5).

From the spiral canal canals branch off also towards the umbilicus. In *Rotalia polystomelloides* they run straight

on to the ventral side and there they open. In *Rotalia schroeteriana* they form an irregular network and also open on the ventral side of the shell in the umbilical region (J. Hofker, *l. c.* 1927, pl. xix. figs. 8 and 9).

This system is also typically shown in the Calcarinidæ and the Polystomellidæ. In the latter the system is double, as there is an umbilicus at both sides of the test.

The family of the Rotaliidæ thus includes the subfamilies Rotaliinæ, Calcarininæ, and Polystomellinæ.

In the Nummulitidæ it is possible to separate a primary and secondary canal-system. The primary canals are formed in *a single* chamber-wall, really as a canal. The secondary canals are formed when two chamber-walls meet, grow together, and some space is left between them. (In this way the Rotalid system is formed.) The primary canal-system is to be found at the marginal side of the chambers. In the first rows it forms a simple canal, but later on by anastomosing the "marginal cord" is formed. From this marginal cord there extend many canals mostly secondarily formed. So there is really a pronounced difference from the Rotalid spiral system, this being formed secondarily at the base of the chambers and extending along the umbilical side.

The Nummulitidæ have an embryonic structure that in the megalospheric forms does not show a so-called "raspberry-structure," like the Planorbulinidæ, which, moreover, do not possess a canal-system.

Thus defined, the true Nummulites are: — *Assilina, Nummulites, Operculina, Heterostegina, Spiroclypeus, Cycloclypeus* (J. Hofker, "De Nummulitidæ," Tijdschr. Nederl. Dierk. Vereen. (2) pt. xx. 1927, p. 3).

Description of the Material.

L. M. Davies kindly sent:—

Dictyoconoides kohaticus, from the uppermost Laki beds of Kohat.

D. kohaticus, from the uppermost Laki beds of Bahadur Khel.

D. kohaticus, var. *spintangiensis*, from Spin Tangi.

D. vredenburgi, from the middle Laki beds near Hindu Bagh.

D. haimei, from the uppermost Ranikot beds at Thal.

For this beautiful material we are greatly indebted to him, and now express to him our best thanks.

According to L. M. Davies the geological succession is as follows:—

Lutetian	Khirthar.
Ypresian	Laki. Uppermost Ranikot.
Landenian	Ranikot.

(L. M. Davies, "Notes on the Correlation of Pinfold's Chharat Series with the Eocene Stages of Sind and Europe," Transact. of the Mining & Geol. Inst. of India, part 3, 1926, p. 195.)

In his letter of 24 June, 1928, Davies evidently regards the uppermost Ranikot as also Landenian, since he places *Dictyoconoides haimei* and other types of the Ranikot and uppermost Ranikot altogether in the Landenian.

It may be remarked that the terms Landenian and Ypresian are not always used, and by E. Haug they are included to the Londinian (E. Haug, 'Traité de Géologie,' part ii. fasc. 3, pp. 1424, 1419). Also Haug does not refer the Londinian to the Eocene (as Davies and others do Landenian and Ypresian), but to the Palæocene.

Dictyoconoides kohaticus, Davies. (Pl. VI. figs. 1–4.)

Conulites kohaticus, Davies (L. M. Davies, "Remarks on Carter's Genus *Conulites* etc.," Rec. Geol. Survey of India, vol. lix. part 2, 1926, p. 240, pl. xvi. figs. 1–4, pl. xvii. figs. 5–5 *c*).

Conulites kohaticus, var. *spintangiensis*, Davies (L. M. Davies, *l. c.* p. 245, pl. xvii. fig. 6).

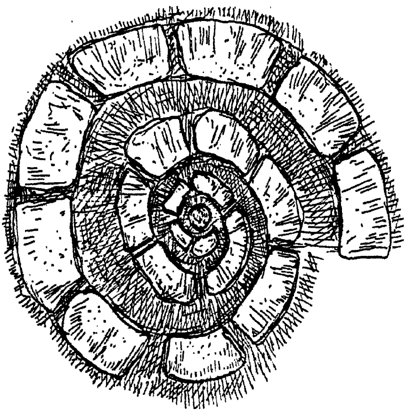
The sample contained three distinctly different types, though it was quite obvious that they must belong to the same species, their only difference being the more or less conical shape and (as will be shown further on) the dimensions of their embryonic chamber.

One type was a rather high conical form, having a basal diameter of about 5 mm. and a conical height of 2 mm. (Pl. VI. figs. 4 *a*, *b*). A slide made through the embryonic apparatus showed a large first chamber (text-fig. 1).

The second type also was rather conically shaped, though much less than the first. The basal diameter was about 7 mm. and the conical height 2 mm. or little less (Pl. VI. figs. 3 *a*, *b*). The slide showed beyond doubt that the form was a megalosphericone (text-fig. 4).

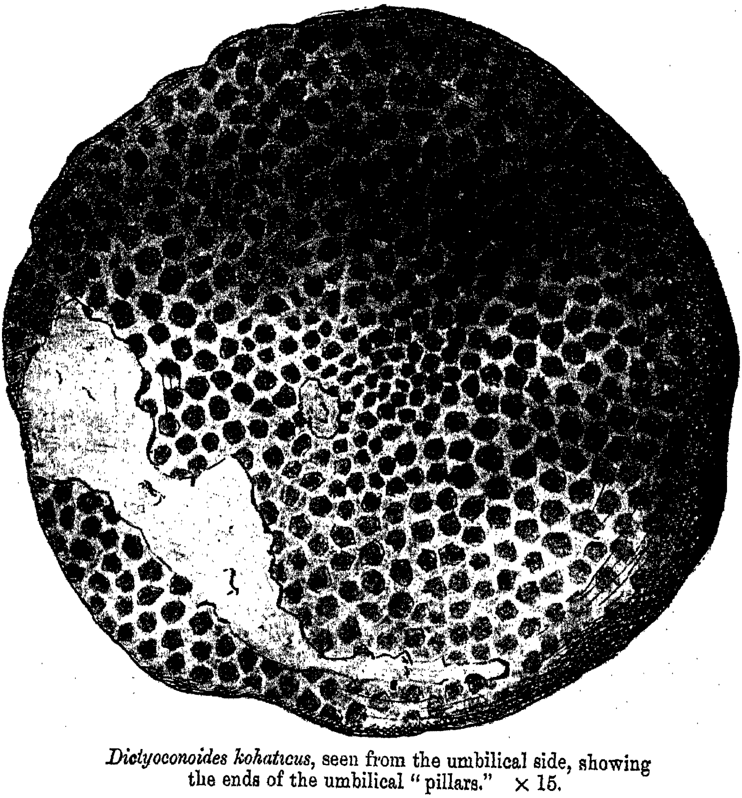
The third form is a much more flattened type of 8 and more mm. basal diameter, while the conical height never attained 2 mm. and usually was about 1 mm. (Pl. VI. figs. 2 *a*, *b*).

Text-fig. 1.



Dictyoconoides kohaticus. Cross-section through the embryonic apparatus. Megalospheric type. × 80.

Text-fig. 2.

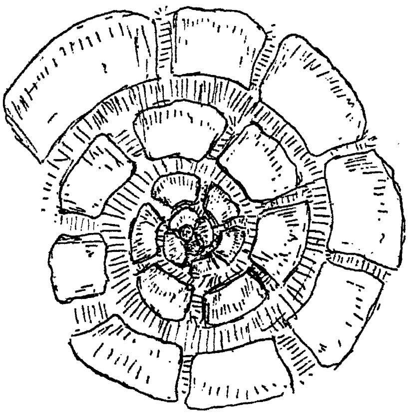


Dictyoconoides kohaticus, seen from the umbilical side, showing the ends of the umbilical "pillars." × 15.

The section, horizontally through the embryonic apparatus, showed a microspheric first chamber (text-fig. 3).

It was not always easy to decide whether an individual belonged to the effilated or the flattened conical type. But that does not appear to be astonishing, for if Hofker's ideas about the subject are correct, there must needs be a large series of individuals, which, although belonging to the megalospheric generations, show more or less slight gradations and variations towards the microspheric type.

Text-fig. 3.



Dictyoconoides kohaticus. Cross-section of the microspheric embryonic apparatus. × 80.

But they are always distinctly separated from the true microspheric generation. In a hundred specimens of *Dictyoconoides kohaticus* there were nine microspheric individuals, seven megalospheric high conical and eighty-four megalospheric lower conical individuals—an abundance of the intermediate megalospheric form that might be expected on the theory of heterogamy (trimorphism).

With regard to the description of the outer habitus of the species, I may refer to the original description of Davies (L. M. Davies, "Remarks etc.," *l. c.* 1926, p. 241).

In horizontal section, the figure one can see is different, according to the height of the section.

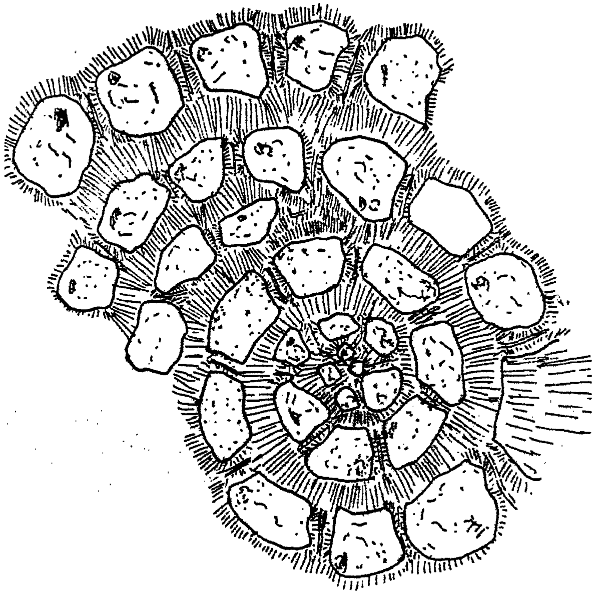
The upper section shows the initial chamber and the first whorls of the chamber-spiral. The megalospheric individuals (text-figs. 1, 4) show distinctly a first chamber, followed by the rest of the chambers, which are all to be seen apart. The microspheric ones (text-fig. 3) show an initial chamber,

with a first row of partly underlying, though spirally ranged, following chambers (the apparent disorder of the first four or five chambers does not form a "raspberry-apparatus," as is, for instance, the case in the Planorbulinidæ).

It is obvious that in the microspheric forms the first whorls show chamberlets of a much smaller size than the equivalent chambers of the megalospheric forms.

The walls are calcareous and distinctly, though finely, porous, and the septa between the chambers are penetrated

Text-fig. 4.



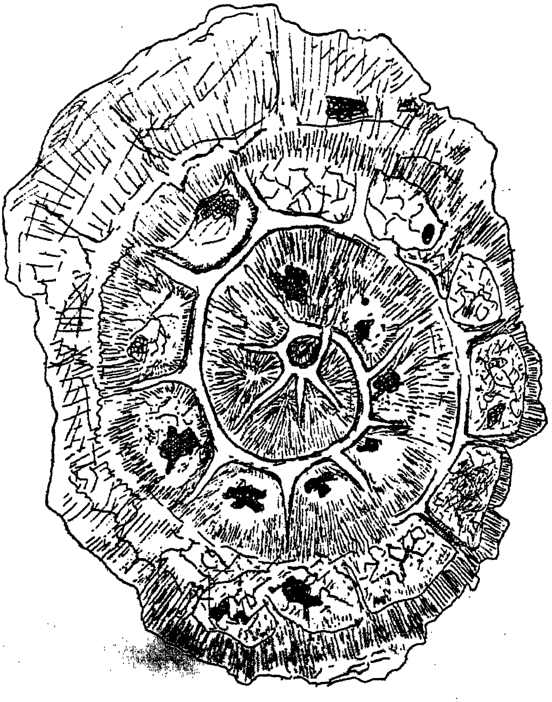
Cross-section of *Dictyoconoides kohaticus*, through the embryonic apparatus, showing the megalospheric character and the beginning of an intercalary whorl. × 60.

by a canal, or rather (though this cannot be seen in a horizontal section) by a system of canals.

The origin of those canals is to be seen in a section cut immediately under the first whorls (text-fig. 5). There appears a beautiful spiral canal formed quite like that figured by Hofker in his work on the 'Siboga' Foraminifera (J. Hofker, "The Foraminifera of the 'Siboga' Expedition," *l. c.* pl. xix. figs. 12, 9, 4, and others). It branches off between the chambers.

As all the examined *Dictyoconoides* are fossilised specimens and during the fossilisation were totally filled up with calcite, it is not possible to apply here the "canada-balsam method" of Hofker. But in his habitus the spiral canal of *Dictyoconoides kohaticus* resembles perfectly that of *Rotalia schroeteriana* and *R. polystomelloides*, which are looked

Text-fig. 5.



Cross-section of *Dictyoconoides kohaticus* just below the embryonic apparatus, showing the typical Rotalid spiral canal. × 60.

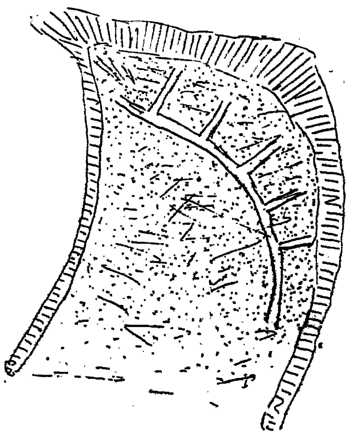
upon by Hofker as possessing a typically Rotalid canal-system. As in the forms here mentioned, the spiral canal runs on the umbilical side of the spiral of chambers, quite near to the chambers themselves. Besides, I could observe (near A in text-fig. 7) a bifurcating end of an interseptal canal. Here and there it was quite possible to observe the interseptal canals giving off their branches (text-fig. 6). So it does not appear unreasonable to conclude that the spiral canal-system is quite on the plan indicated in plate xix. fig. 4 of the already-mentioned 'Siboga' work of Hofker.

A yet lower cut section may reveal the secret of the structure of the umbilical canal-system, but, as I could better trace this in *Dictyoconoides vredenburgi*, I postpone the discussion of it until I describe that species.

A section not high above the base shows some spiral rings of chambers and cross-sections of the "columns" and interlocated "chamberlets" that form part of the umbilical system. I also postpone their interpretation till the discussion of *Dictyoconoides vredenburgi*.

A transverse section through the initial chamber (text-fig. 7) shows a cross-section of the chamber-spiral covered

Text-fig. 6.



Section through septum, showing an interseptal canal with branches. × 180.

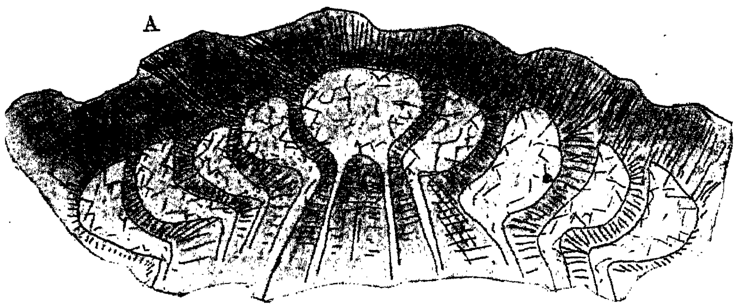
towards the outer whorl with a—near the top thickest—layer of finely perforated chalk-material, which bears here and there little outgrowths, in which one can now and then detect a bifurcation of the interseptal canal. Those granulations are not regularly spread, but generally they are more closely packed in the upper region.

The chambers open at the base towards the umbilical region (text-fig. 8). From every chamber-wall emerges a basally directed pillar-shaped prolongation and a more horizontally directed wall. They are placed almost vertically to each other, and so the transverse section gives the impression of a chamber-filled umbilical region.

Yet by thoroughly studying, comparing, and combining horizontal and vertical sections, it must become clear that there can only be recognised a system of canals (umbilical canal-system) which are connected with the inner contents of the chambers. So I must decidedly oppose the opinion of Davies and other authors, who speak about the openings as "secondary chambers."

It is not easy to indicate on the transverse sections where the spiral canal has been cut, but that is not so strange, owing to the trifling width of the canal and the complete calcifying of the test.

Text-fig. 7.



Dictyoconoides kohaticus. Transversal section through the top, showing some chambers and a part of the umbilical region. Also the umbilical opening of the chambers and the upper part of the "pillars" are to be seen, as well as the thickness of the calcareous skin, with its granulations. Near A can be observed that canals end in those granulations. × 60.

As to the variety *spintangiensis*, I can see no clear difference between it and the microspheric form of *Dictyoconoides kohaticus.* Indeed, there are individuals of *D. kohaticus* and of the variety *spintangiensis*, both from the collection of Davies, which I cannot possibly distinguish from each other.

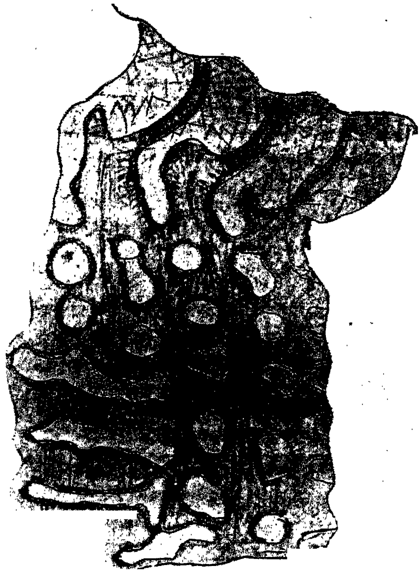
The differences which guided Davies in his creating the new species were (1) its being bigger, (2) its being flatter, than the normal type.

Davies adds: "This appearance of flatness is due to the thickening and turning upwards of the outer rim of the test."

It appears to me that these differences are not of so great an importance, as they show every gradation to the original species, and may not always be distinguishable from it with certainty.

Now, it is an essential fact, stated by Davies, that the variety *spintangiensis* always occurs with the original *Dictyoconoides kohaticus,* but is found in larger quantities in the southern parts of the district where *kohaticus* is found. He adds in an important note: "It is noticeable, though, that the specimens from Lower Sind, still further south, often approximate to the normal *kohaticus* type, rather than to the *spintangiensis* variety" (L. M. Davies, "Remarks etc.," 1926, *l. c.* p. 245).

Text-fig. 8.



Transversal section through *Dictyoconoides kohaticus* (part), showing part of the umbilical system and chambers. In the vertical "pillars" canals are running. × 60.

A remarkable fact, shown by sections of the variety *spintangiensis*, is that these forms are all microspheric, and there are no megalospheric specimens as would be expected if the variety *spintangiensis* really was a variety.

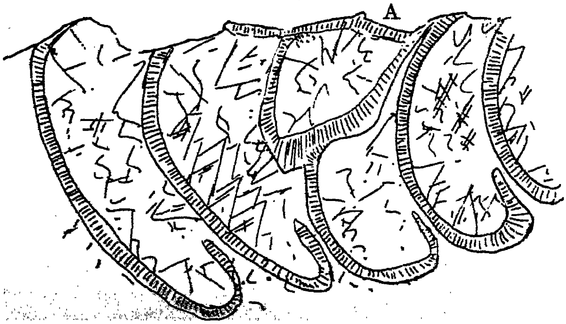
Besides the Spintangi-zone, where the variety has been found in larger quantities, has some peculiarities, so that it usually is placed in the lower Khirthar, which immediately follows the Laki-series. Davies is inclined to determine the strata as a *special facies* of the uppermost Laki and basal Khirthar series.

So, on the whole, I am inclined to consider *Dictyoconoides kohaticus*, var. *spintangiensis*, Davies, as a microspheric *Dictyoconoides kohaticus*, Davies, that may perhaps in the special life-circumstances of the Spintangi-facies have developed some deviating qualities in outer shape.

I could not quite make out the difference between *D. kohaticus* and *D.* (*Conulites*) *cooki*, Carter. It seems that Davies also had some doubts as to the difference between those two species (L. M. Davies, "Remarks etc.," 1926, *l. c.* pp. 243–244). Davies tried to check his opinion by studying the type-specimens of Carter, but they proved to be lost. So he could not confirm his opinion in this way.

Of course, I cannot decide here, but I should not be much surprised if *Dictyoconoides cooki*, Carter, proved to be nothing else than the megalospheric high conical form of *D. kohaticus*, Davies. But as long as there is no actual proof of this surmise, we must distinguish the two species.

Text-fig. 9.



Dictyoconoides vredenburgi. Transversal section, shewing some of the chambers, with their openings towards the umbilicus and near A the beginning of an intercalary whorl. The chambers are filled up with calcite crystals. × 80.

Dictyoconoides vredenburgi, Davies.

Conulites vredenburgi, Davies (L. M. Davies, "Remarks on Carter's Genus *Conulites* etc.," Records of the Geol. Survey of India, vol. lix. part 2, 1926, p. 246, pl. xvii. figs. 7–7 *b*).

Davies says about this species that it differs specifically from *D. kohaticus*. "It is a relatively small flat form, with cortical chambers so large in proportion to the test as a whole, as to constitute in my opinion a specific difference in type" (L. M. Davies, "Remarks," 1926, *l. c.* p. 247).

This is really an obvious difference from *kohaticus*, the more so, since—as Davies also states—there are no gradations between this type and *D. kohaticus*.

It also does not always occur amidst the other Foraminifera; it is found by Davies in one place only.

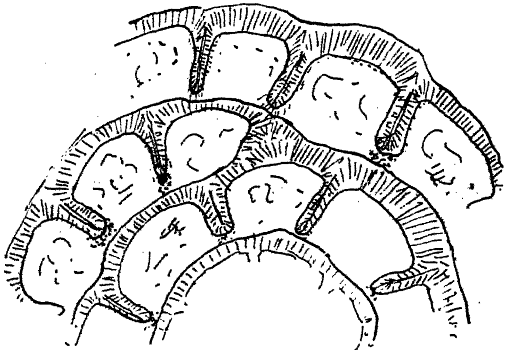
Examining the received sample (altogether six specimens) it was possible to distinguish a flat and a more conical type, and a slide demonstrated that the flat individual belonged to the microspheric generation, the more conical to a megalospheric one.

For these reasons I quite agree with Davies in considering it as a species different from *kohaticus*.

The inner structure—except the bigness of the chambers—did not demonstrate any difference from that of *Dictyoconoides kohaticus*. Here also the spiral canal could be traced in its typical Rotalid development.

A transverse section showed the structure known already from *D. kohaticus*. Only the connection of the chamber-contents with the umbilical canal-system was very clearly demonstrated here (figs. 8, 9). One wall strongly curves

Text-fig. 10.

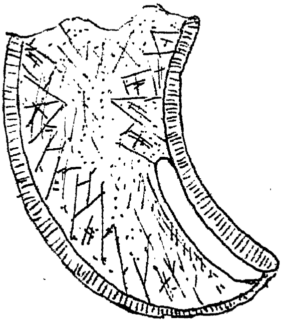


Cross-section showing the connection of the chambers by the apertures and the beginning of an intercalary whorl. × 80.

to the umbilical side and runs a little distance upward, parallel to another wall. Through the opening thus formed between them the communication is created. Also two "pillars" of calcareous material run, one vertically, the other more horizontally, which border a system of openings, the umbilical canal-system, that by the fore-mentioned ventral opening communicates with the chamber. In this transverse section, too, it is difficult to indicate where the spiral canal runs. In horizontal section it runs beneath the marginal walls between two whorls (cf. *Rotalia schroeteriana*).

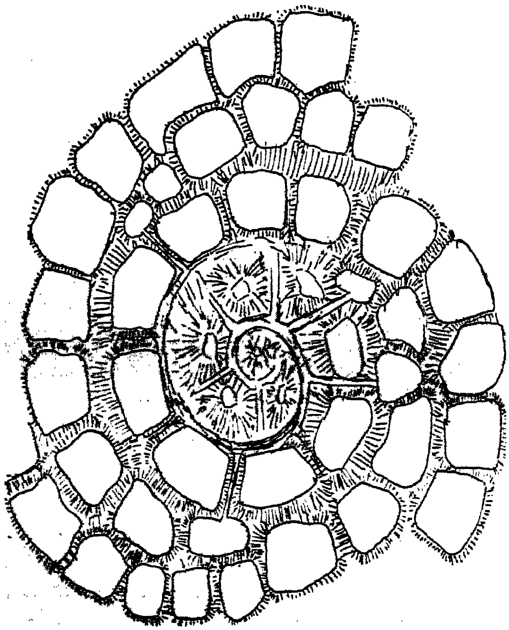
Pl. V. shows a reconstruction of a part of a *Dictyoconoides vredenburgi*. It does not greatly differ from *D. kohaticus*.

Text-fig. 11.



Section through septum, showing the aperture. ×120.

Text-fig. 12.



Cross-section of *Dictyoconoides vredenburgi*, showing the connection of the spiral canal with the first chambers of the intercalary whorls. ×60.

In one horizontal slide I thought I could—though not with the greatest certainty—see something of the genesis of the intercalary whorls (text-figs. 9, 10, and 12).

One of the branches of the spiral canal—an interseptal one—seemed to pass straight on to the first chamber of the intercalary whorl wherein it opened.

In the cross-section here published (text-fig. 12) there is one place in the regular arrangement of the chambers where it seems that two chambers struggle for a place in the spiral, one lower, the other higher. The interpretation may be that—by what cause is not clear—a chamber is formed at the end of the branch of the spiral canal near the last chamber of the existing whorl. The forming of the first intercalary chamber and a new chamber of the original spiral are simultaneous and one chamber displaces the other. In the forming of the next two chambers this process is continued, and so, finally, the intercalary whorl has assumed its place amidst the original ones. I should not like this to be considered a certainty, but I give it as a possibility that, in my opinion, has some probability.

Conclusions.

We can gather the following facts from the notes given above:—

1. Hitherto especially the outer shape has been used to classify *Dictyoconoides*.

2. *Dictyoconoides* possesses a typical Rotalid canal-system, *i. e.*, a spiral canal, with branches towards the umbilicus and in the septa. The branches in the septa bifurcate in many places and the branches in the umbilicus are part of the "umbilical canal-system" that corresponds with the chambers.

3. *Dictyoconoides* also shows other Rotalid characteristics: a spiral of chambers, conical shape, finely perforate walls, a closed umbilicus.

4. So *Dictyoconoides* must be considered to be a Rotalid.

5. The above-mentioned characteristics classify *Dictyoconoides* as a typical *Rotalia.*

6. The name *Dictyoconoides* is to be replaced by the name *Rotalia.*

7. *Rotalia kohaticus,* Davies, typically shows *trimorphism.*

EXPLANATION OF THE PLATES.

Plate V.

Reconstruction of a part of *Dictyoconoides.*

Plate VI.

Dictyoconoides kohaticus, Davies.

X.—*New or little-known* Tipulidæ (*Diptera*).—XLIV. *Australasian Species.*

By Charles P. Alexander, Ph.D., F.E.S., Massachusetts Agricultural College, Amherst, Massachusetts, U.S.A.

The crane-flies discussed in this paper are from Queensland, New South Wales, Victoria, and West Australia, and were collected by my friends Messrs. Clark, Davidson, Dodd, Ferguson, Heron, Mathews, Perkins, Taylor, and Wilson, to whom my deepest thanks are extended. Where not indicated to the contrary, the types of the novelties are preserved in my collection.

Dolichopeza (*Dolichopeza*) *illingworthi*, sp. n.

Thorax almost uniform fulvous-yellow, the pleura paler yellow; legs brown, the genua scarcely brightened; posterior tibiæ broadly white at tips; fore and middle basitarsi brown, the tips white; posterior basitarsi pure white; wings whitish subhyaline, the apex and a narrow seam on anterior cord dark brown; abdominal segments black, ringed at near mid-length with ochreous.

Male.—Length about 7·5 mm.; wing 7–7·5 mm.

Frontal prolongation of head obscure yellow, the palpi dark brown. Antennæ (♂) of moderate length, if bent backward extending to beyond the base of the abdomen; scapal segments obscure yellow, the flagellum dark brown. Head dark brown, the anterior portion more brownish yellow.

Thorax almost uniform fulvous-yellow, the mesonotum immaculate, the pleura clear yellow, palest ventrally. Halteres elongate, pale brown, the knobs dark brown. Legs with the coxæ and trochanters pale brown; femora brown, the bases paler, the genua scarcely brightened; tibiæ dark brown, the distal third of posterior tibiæ snowy white; basitarsi dark brown, the tips and remainder of tarsi snowy white; on posterior legs the tarsi are uniformly whitened. Wings whitish hyaline, the apex narrowly dark brown; stigma and a narrow seam on anterior cord dark brown; veins brownish black. Venation: cells of medial field relatively shallow; *m–cu* nearly its own length before fork of *M*; cell *2nd A* very narrow on basal half, the outer half more expanded to form a weak anal angle.

Abdomen black, the segments ringed with ochreous at or beyond mid-length; hypopygium chiefly ochreous, relatively large. Male hypopygium with the tergite nearly transverse,

with an acute spine on either side, the space between nearly transverse, in its median portion produced caudad into a low transverse median lobe. Outer dististyle toothed on mesal face shortly before apex.

Hab. North Queensland.

Holotype, ♂, Kuranda, Cairns District, altitude 1100 feet, on window, March 1921 (*A. P. Dodd*).

Paratopotype, ♂.

I take great pleasure in naming this interesting species in honour of Dr. James F. Illingworth, to whom I am indebted for many Tipulidæ from the Cairns District. The species is allied to *D. varipes*, Skuse, differing especially in the details of coloration and structure of the male hypopygium.

Dolichopeza (*Dolichopeza*) *davidsoni*, sp. n.

General coloration dark brown; pleura pale yellow, variegated with dark brown; legs brown, the femoral tips, tibial bases and tips, extreme proximal ends of basitarsi, and the outer tarsal segments white; wings greyish, the apex and veins beyond cord conspicuously infumed; abdominal tergites dark brown, the outer sternites ringed with yellow.

Male.—Length about 6·5 mm.; wing 7·2–7·4 mm.

Female.—Length about 8 mm.; wing 7·7 mm.

Frontal prolongation of head brownish yellow, dark brown ventrally; palpi dark brown. Antennæ with the scape and basal segments of flagellum pale yellow, the outer segments dark. Head brown, with a sparse grey pruinosity, the anterior vertex and front restrictedly light yellow.

Pronotum light yellow, the cervical sclerites dark brown. Mesonotal præscutum dark brown, the usual stripes scarcely evident, confluent, the humeral region restrictedly light yellow; scutal lobes dark brown, the median region very restrictedly pale; scutellum and postnotum uniformly brown. Pleura pale yellow, conspicuously variegated with dark brown, this including the anepisternum, together with the dorso-pleural region immediately dorsad of it, the ventral sternopleurite, and the meron. Halteres elongate, pale, the knobs dark brown. Legs with the coxæ and trochanters pale yellow; femora pale basally, deepening into brown outwardly to produce a darker subterminal ring, the tips narrowly whitened; tibiæ dark brown, the bases narrowly whitened, the tips broadly pure white; proximal ends of basitarsi more or less whitened, especially evident on the type, where on the hind legs it includes an area only slightly less than the tibial apex; remainder of basitarsi dark

brown, the tips and tarsal segments 2 to 4 white; terminal segment infuscated. Wings with a greyish tinge, cells *C* and *Sc* a little darker; stigma elongate, dark brown; wing-apex broadly infumed, connected by broad seams along the veins with a large seam on the anterior cord; medial veins, *m–cu*, and distal section of Cu_1 similarly seamed; whitish areas before and beyond the stigma; veins dark brown, more cream-coloured in the pre-stigmal pale area. Venation: forks of medial field relatively shallow; *m–cu* more than two-thirds its own length before the fork of *M*; cell *2nd A* narrow.

Abdominal tergites uniformly dark brown; basal sternites pale yellow, narrowly ringed with dark brown; subterminal segments with the caudal margins of the segments yellow, the amount increasing on the outer segments. Ovipositor with the genital shield and basal half of the tergal valves blackened, the tips of the latter and the sternal valves pale yellow.

Hab. South Queensland, New South Wales.

Holotype, ♀, Mt. Tamborine, South Queensland, altitude 2000 feet, November 1928 (*W. H. Davidson*).

Allotype, ♂, Eastern Dorrigo, New South Wales, altitude 2000–3000 feet, February 27, 1929 (*W. Heron*).

Paratypes, ♂ ♀, with the allotype.

The species is named in honour of the collector of the type, Mr. Will H. Davidson. *Dolichopeza davidsoni* is allied to *D. annulipes*, Skuse, differing in the wing-pattern, coloration of the thoracic pleura, and details of the leg-pattern.

Dolichopeza (*Dolichopeza*) *dorrigensis*, sp. n.

General coloration dark brown; thoracic pleura with a broad oblique yellow stripe; legs dark brown, the genua, tips of all tibiæ, proximal ends of all basitarsi, and outer tarsal segments snowy white; wings greyish subhyaline, virtually unmarked except for the stigma; *m–cu* about one-third its length before the fork of *M*; abdominal tergites dark brown, with whitish-yellow lateral spots; sternites whitish yellow, with a median series of brown spots.

Female.—Length about 8 mm.; wing 7·8 mm.

Frontal prolongation of head pale yellow; palpi brown. Antennæ dark brown, including the scape; flagellar segments elongate-cylindrical, the verticils longer than the segments. Head rich cinnamon-brown, the anterior vertex and front light yellow.

Pronotum yellow laterally, narrowly dark brown behind. Mesonotum brown, the humeral region of the præscutum restrictedly pale yellow, the scutal region a little brightened. Pleura obliquely lined with pale yellow and dark brown, the yellow band extending from the humeral region to the posterior coxæ, margined in front by a narrow brown line, margined posteriorly by a somewhat wider line of the same colour; propleura extensively pale yellow. Halteres dusky, the knobs dark brown. Legs with the coxæ pale yellow, the base of the fore coxa darkened; trochanters yellow; femora dusky at base, passing into dark brown, the genua narrowly but conspicuously white; tibiæ dark brown, the tips of all legs conspicuously snowy white, broadest on the hind legs; proximal ends of basitarsi narrowly but conspicuously white, the major portion dark brown, the tips again white; remainder of tarsi white. Wings greyish subhyaline, the stigma conspicuously dark brown; a vague, scarcely indicated brown seam on anterior cord; pale areas before and beyond the stigma scarcely indicated; wing-margin in cell Sc_2 narrowly infumed; veins dark brown. Wing rather conspicuously petiolate. Venation: Sc_1 distinctly preserved; forks of medial field relatively deep; *m–cu* at about one-third its length before the fork of *M*; cell *2nd A* unusually long and narrow.

Abdominal tergites dark brown, each segment with a conspicuous yellow lateral spot on posterior ring; sternites greenish, the median portion extensively yellow, with a conspicuous series of brown markings distributed the entire length; in certain lights the yellow coloration of the abdomen is conspicuously white pruinose. Ovipositor with the valves chiefly yellow; tips of the short sternal valves broadly and conspicuously blackened.

Hab. New South Wales.

Holotype, ♀, Brooklana, East Dorrigo, altitude about 2000 feet, March 3, 1928 (*W. Heron*).

Dolichopeza dorrigensis is allied to *D. annulipes*, Skuse, differing in the details of coloration of the wings, legs, and abdomen.

Macromastix (*Macromastix*) *clitellaria*, sp. n.

General coloration of mesonotal præscutum and scutal lobes polished black (♂), more obscurely darkened (♀); postnotal mediotergite yellowish testaceous, with two black spots on caudal margin; legs long and slender, black, the

femoral bases broadly obscure yellow; wings with a strong dusky suffusion, the prearcular region and cells *C* and *Sc* dark brown; base of abdomen (♂) fulvous-yellow, the terminal portion black.

Male.—Length about 11–12 mm.; wing 15 mm.

Female.—Length about 10·5–11 mm.; wing 13·5 mm.

Frontal prolongation of head of moderate length only, a little more than one-half the remainder of head, dark brown, paler at apex; nasus very long and slender, tufted with conspicuous setæ; palpi black. Antennæ short, only about as long as the head excluding the frontal prolongation, apparently only 11-segmented; first scapal segment obscure yellow, darkened dorsally; second scapal segment light yellow; flagellum black, the base of the first segment paler; first flagellar segment subpyriform, the succeeding segments becoming more slender; verticils short and inconspicuous. Head dark brown, the posterior orbits narrowly and irregularly light grey.

Pronotum black, pollinose. Mesonotal præscutum (♂) with an extensive polished black dorsal shield, the narrow lateral margins yellowish-grey pruinose; scutal lobes similarly polished black; median area of scutum, the scutellum, and most of the postnotal mediotergite yellowish testaceous, the caudal margin of the latter with two paired black spots. In the female the polished areas of the male are dull, being covered with a sparse pollen. Pleura heavily light grey pruinose, including the dorso-pleural region; pleurotergite with the dorsal portion pale, pruinose, the ventral portion clearer grey. In the female the dorsal portion of the pleurotergite is glabrous. Halteres brownish yellow, the knobs infuscated. Legs with the coxæ light grey; trochanters obscure yellow; femora chiefly black, their bases broadly obscure yellow, the amount of the latter somewhat more extensive on the middle and posterior femora; remainder of legs black; legs very long and slender, the posterior basitarsi longer than the tibiæ. Wings with a strong dusky suffusion, the stigma and cell Sc_1 more yellowish; prearcular region and cells *C*, *Sc*, and small adjoining cells dark brown; veins black, the obliterative areas relatively restricted; distal end of R_{1+2} entirely pale; *Rs* entirely pale brown, without macrotrichia. Macrotrichia lacking on veins beyond the cord, with the exception of *Sc* and R_1. Venation: R_3 nearly in alignment with R_{2+3}, the latter subequal to *Rs*; cell M_1 deep, the petiole subequal to or longer than *m*; cell *2nd A* very narrow.

Abdomen with the basal segments fulvous-yellow, the distal half or less black, the outermost segments pruinose; sternites similarly coloured; hypopygium entirely dark. In the female the abdominal tergites are very extensively covered with a yellowish-grey pruinosity, only the base of tergite 2 being nitidous; basal sternites more extensively glabrous.

Hab. Victoria.

Holotype, ♂, Bogong High Plains, altitude 5600–6000 feet, January 1928 (*F. E. Wilson*).

Allotopotype, ♀.

Paratopotypes, 2 ♂♂.

Type returned to Mr. Wilson.

Macromastix (*Macromastix*) *mathewsi*, sp. n.

Male.—Length 11–14 mm.; wing 13–15 mm.

Female.—Length 8·5–12 mm.; wing 9·5–14 mm.

Allied to *M. constricta*, Skuse (New South Wales), differing especially in the details of coloration and structure.

Frontal prolongation of head a little shorter than in *constricta*, opaque by a conspicuous microscopic yellow pubescence, obscure yellow with a narrow dark brown or black lateral line; nasus shorter; palpi black. Antennæ with the scape yellow, the flagellum entirely black. Head yellowish grey.

Mesonotal præscutum yellowish grey, opaque, with four poorly delimited brownish-grey stripes, the intermediate pair confluent and more greyish behind; scutellum and postnotum with an abundant appressed yellowish pubescence. Pleura conspicuously light grey, including the anepisternum, sternopleurite, and pteropleurite, the pleurotergite abruptly yellowish. Halteres dark brown, the stem paler. Legs with the coxæ greyish, the mid-coxæ more clearly so; trochanters obscure yellow; femora yellow, the tips broadly blackened, this including approximately the distal fourth; tibiæ brownish yellow, the bases very narrowly, the tips broadly blackened; tarsi black; all tarsi relatively short, as in *constricta*. Wings broader than in *constricta*, strongly infumed, the base and costal border darker, but not contrasting so conspicuously with the remainder of the wing. Venation: cell *2nd A* narrow, but still much wider than in *constricta*.

Abdominal tergites (♂) dark brown, the basal segments yellow on lateral margins, this narrowing behind; sternites yellow, the subterminal segments black, sparsely pollinose;

hypopygium pale. In the female the abdomen is heavily pruinose, the lateral margins and ovipositor fulvous.

Hab. West Australia.

Holotype, ♂, South Perth, October 20, 1927 (*W. H. Mathews*).

Allotopotype, ♀, September 22, 1927.

Paratopotypes, numerous ♂ ♀, September 22, 1927; October 20–30, 1927; *paratypes*, ♂ ♀, Redlands, September 11, 1927 (*W. H. Mathews*).

"All caught in my garden on the side of a small hill."

I take great pleasure in naming this species in honour of the collector, Mr. Wallace H. Mathews. Although closely allied to *M. constricta*, the present species is clearly distinct. The most conspicuous differences lie in the frontal prolongation of the head, the wings, and coloration of the male hypopygium.

Macromastix (*Macromastix*) *clarkiana*, sp. n.

Male.—Length about 12–13 mm.; wing 15–16 mm.

Female.—Length about 13 mm.; wing 15 mm.

Closely allied to *M. constricta*, Skuse (New South Wales), agreeing in the general coloration of the body and wings, differing in the details of pattern and structure.

Frontal prolongation of head slender, as in *constricta*, but slightly less constricted before mid-length, chestnut-brown. Antennæ with the scape bright yellow, the flagellum black; flagellar segments beyond the fourth narrowed and shortened, the terminal seven shorter than the preceding four taken together. Two more or less distinct brown spots between the eyes.

Ground-colour of the præscutum yellowish grey, clearer laterally, with four entirely separated brown stripes; scutellum and postnotal mediotergite conspicuously yellow pollinose. Pleura chiefly clear grey. Legs with the femora and tibiæ fulvous, tips broadly blackened; tarsi relatively short, as in *constricta*. Wings with a strong dusky grey ground-colour, the pattern distinct from *constricta*; prearcular region darkened, the costal region rather narrowly of the same colour, the amount decreasing toward the stigma, which is chiefly yellow; in cell *R* only about the basal half of the cell is darkened; no distinct dark seam in cell *M* adjoining vein Cu_1, except at base; cell Cu_1 and adjoining portions of cells *M* and *Cu* conspicuously light cream-yellow; veins dark. Wings broader than in *constricta*, especially in the anal region. Venation: cell *2nd A* narrower than in *mastersi*, but broader than in *constricta*.

Abdomen as in the group, the basal segments yellow, the apex, including hypopygium, black. In the female the abdominal tergites are more greyish, with a broad dark brown sublateral stripe on either side; basal segments laterally and the genital segments fulvous-yellow; sternites yellow, the caudal margins of sternites 5 and 6 light grey. Male hypopygium as in *constricta*, but inner dististyle, at base of the elongate rod-like extension, provided only with setæ or weak spines. In *constricta* this region of the style is provided with a small group of short black spines.

Hab. Victoria.

Holotype, ♂, Cann River, November 1928 (*J. Clark*).

Allotopotype, ♀.

Paratopotypes, several ♂ ♀.

Type in the National Museum, Victoria.

I take great pleasure in naming this species in honour of the collector, Mr. John Clark.

Limonia (*Geranomyia*) *bogongicola*, sp. n.

General coloration reddish yellow, heavily variegated with black; rostrum moderately elongate; femora brownish yellow, the tips broadly blackened; wings whitish to yellow, with a brown pattern; male hypopygium with the spines of the short rostral prolongation of the ventral dististyle of moderate length, but exceeding the prolongation itself.

Male.—Length (excluding rostrum) about 8–9 mm.; wing 8·5–10 mm.; rostrum about 3 mm.

Female.—Length (excluding rostrum) about 12–13 mm.; wing 10·5–11·5 mm.; rostrum about 4 mm.

Rostrum black, including the maxillary palpi, the latter 3-segmented; rostrum of moderate length only; subequal to the combined head in thorax in male, somewhat longer in the female. Antennæ black throughout, the basal segments weakly pruinose; flagellar segments cylindrical, the outer segments gradually increasing in length. Head black, pruinose.

Pronotum black, pruinose, restrictedly obscure reddish laterally. Mesonotal præscutum deep reddish, with three broad black stripes that restrict the interspaces; scutum brownish black; scutellum abruptly pale yellow, with a dark basal median spot; postnotal mediotergite dark brown, sparsely pruinose, the antero-lateral portions obscure yellow. Pleura chiefly black, sparsely pruinose, with vague indications of paler areas. Halteres yellow, the knobs weakly infumed, the stem fringed with setæ. Legs with the coxæ dark brown, more yellowish apically, the posterior coxæ more extensively

so; trochanters obscure yellow; femora yellow basally, darker outwardly, the tips broadly blackened, in cases with a very indistinct pale apex; tibiæ brown, the tips blackened; tarsi black. Wings whitish subhyaline, more yellowish in female, with a restricted dark pattern, including the stigma, clouds at origin of *Rs*, Sc_2, along the cord and outer end of cell 1*st* M_2; additional paler washes in the medial, cubital, and anal cells. In the female the ground-colour is more yellowish and the pattern is heavier, including the broad apex and more distinct cloudings in the cubital and anal cells. Costal fringe relatively long and conspicuous in both sexes. Venation: Sc_1 ending opposite two-thirds to three-fourths the length of *Rs*, Sc_2 at its tip; *m–cu* close to the fork of *M*.

Abdominal tergites black, the caudal margins of the segments narrowly and indistinctly silvery; sternites more brownish, the caudal and lateral margins dark; hypopygium yellowish brown. Male hypopygium with the ninth tergite transverse, the caudal margin convex with the median area very gently emarginate. Ventral dististyle with the rostral prolongation short and stout, the two spines arising from tubercles that are placed close together, the spines longer than the entire prolongation. Ædeagus with the surface set with microscopic tubercles. Gonapophyses with the mesal apical lobe relatively prominent, the outer margin with microscopic denticles.

Hab. Victoria.

Holotype, ♂, Bogong High Plains, altitude 5600–6000 feet, January 1928 (*F. E. Wilson*).

Allotopotype, ♀.

Paratopotypes, 1 ♂, 1 ♀.

Type returned to Mr. Wilson.

The species is most closely allied to *L.* (*G.*) *risibilis* (Alexander), differing especially in the diagnostic features listed above.

Limonia (*Geranomyia*) *grampianicola*, sp. n.

Male.—Length (excluding rostrum) about 6·5 mm.; wing 7·5 mm.; rostrum about 2 mm.

Female.—Length (excluding rostrum) about 8 mm.; wing 8·5 mm.; rostrum about 2·4 mm.

Closely allied and generally similar to *L.* (*G.*) *risibilis* (Alexander), differing in the details of coloration and structure of the male hypopygium.

Rostrum of moderate length only, black, including the

palpi. Antennæ black throughout. Head chiefly grey, the vertex with an extensive velvety-black area on either side of the median line, these areas narrower than the median region. Mesonotal præscutum with three conspicuous black stripes, the median one broadest and most intense in front, the posterior portion and lateral stripes paler, the lateral areas crossing the suture on to the scutal lobes; median region of scutum and the scutellum extensively pale. Pleura chiefly yellow, the anepisternum and sternopleurite more infuscated, the dorso-pleural region dusky. All femora with black rings, most extensive on the fore femora, where they are nearly apical, there being only a restricted brightening beyond; on the other legs the pale femoral tups are subequal or a little shorter than the dark rings. Wings pale yellow, with a restricted brown pattern, including, besides the stigma, a small spot on Cu_1 near base, a rectangular area at origin of *Rs*, Sc_2, seams along cord and outer end of cell 1*st* M_2; a grey marginal wash in cell 1*st A*; veins black, *C*, *Sc*, *R*, *Cu*, and the prearcular veins pale. Venation: *Rs* strongly arcuated to angulated and short-spurred at origin; R_3 very long, approximately twice cell 1*st* M_2; cell 1*st* M_2 relatively short and broad, widened outwardly, at distal end about two-thirds as wide as long; *m–cu* variable in position, from one-fifth to approximately one-half its length before the fork of *M*.

Male hypopygium with the dorsal dististyle slender, the distal portion sinuous, the slender tip decurved. Rostral prolongation of ventral dististyle stout, the spines blackened, one arising from a low tubercle, the other more nearly sessile. Gonapophyses with the mesal apical lobe long and slender, their margins smooth. In *risibilis* the dorsal dististyle is differently formed, the rostral prolongation is stouter, and the spines are not blackened.

Hab. Victoria.

Holotype, ♂, Grampians, in fern-gully, October 1928 (*F. E. Wilson*).

Allotopotype, ♀.

Type returned to Mr. Wilson.

L. (*G.*) *annulata* (Skuse) has a somewhat similar leg-pattern, but a very different hypopygium.

Limonia (*Limonia*) *clarki*, sp. n.

General coloration dark grey, the pleura more or less distinctly striped; legs black, the femoral bases paler; wings with a strong brown suffusion, the oval stigma dark brown;

Sc relatively short, Sc_1 ending a short distance beyond the origin of *Rs*.

Male.—Length about 5–5·5 mm.; wing 6 mm.

Female.—Length about 7·5–8 mm.; wing 7–8 mm.

Rostrum elongate, nearly equal to the remainder of the head, black. Antennæ black throughout. Head grey, the posterior vertex infuscated on either side of the median line.

Pronotum and mesonotum dark brown, pruinose, especially laterally; præscutum with a broad median and narrower lateral brown stripes; median region of scutum, scutellum, and postnotum more heavily pruinose. Pleura grey, the dorso-pleural region darker brownish grey; dorsal portion of the sternopleurite paler. In some paratypes the pale pleural stripe is very evident. Halteres pale, the knobs dark brown. Legs with the coxæ brown; trochanters brownish yellow; femora pale basally, passing into black; tibiæ and tarsi black. Wings with a strong brown suffusion; stigma oval, dark brown; narrow vague dusky seams along cord, outer end of cell *1st* M_2, vein *Cu*, and the longitudinal veins beyond cord; veins dark brown. Venation: Sc_1 ending a short distance beyond the origin of *Rs*, Sc_2 at its tip; *Rs* relatively long, angulated near origin; *m–cu* at or close to the fork of *M*.

Abdominal tergites brownish black; sternites more pruinose, the basal sternites paler medially and on caudal margin; hypopygium chiefly dark, the ventral dististyle pale. Male hypopygium with the tergite transverse, the caudal margin gently emarginate. Basistyle with the ventro-mesal lobe low and stout. Ventral dististyle smaller than the basistyle, with a conspicuous cylindrical rostral prolongation that bears two long spines, one slightly more distal in position, a little shorter than the inner; both spines lie in an oval pale depression, the more basal spine from a short enlarged base. Dorsal dististyle a strongly chitinized black hook, the slightly decurved apex acute; margin of curvature of the style with small delicate setulæ. Gonapophyses broad-based, the mesal apical lobe slender.

Hab. West Australia.

Holotype, ♂, Mundaring, August 23, 1926 (*E. W. Ferguson*).

Allotype, ♀, Balingup, August 29, 1926 (*E. W. Ferguson*).

Paratopotypes, 7 ♂ ♀ (*E. W. Ferguson* and *J. Clark*); *paratypes*, 3 ♂ ♀, with the allotype (*E. W. Ferguson*); 4 ♂ ♀, Pemberton, August 28, 1926 (*E. W. Ferguson*); 1 ♂, Donnybrook, August 29, 1926 (*E. W. Ferguson*).

Type in the Macleay Collection.

Limonia clarki is respectfully dedicated to Mr. John Clark, in recognition of his valuable studies on the entomology of West Australia. The species is allied to *L.* (*L.*) *incisuralis* (Skuse) and *L.* (*L.*) *zonata* (Skuse), but is very distinct.

Limonia (*Limonia*) *tamborina*, sp. n.

General coloration yellow, the posterior præscutum and scutum dark brown; scutellum conspicuously whitish; pleura yellow, striped longitudinally with brown; knobs of halteres yellow; femora with a subterminal dark ring, the tips pale; wings cream-coloured, with a sparse dark pattern; *Sc* relatively short, Sc_1 ending shortly before mid-length of the angulated *Rs*; abdominal segments bicolorous, the bases obscure yellow, the apices more narrowly dark brown; male hypopygium with the mesal lobe of basistyle very long and slender, narrowed to an acute chitinized point.

Male.—Length about 5 mm.; wing 6 mm.

Rostrum and palpi black. Antennæ black throughout; flagellar segments oval, with a dense white pubescence and relatively inconspicuous setæ. Head dark brownish grey.

Mesonotum chiefly yellow, the præscutum behind with three confluent brownish stripes; scutal lobes dark brown; median area of scutum and the broad scutellum conspicuously whitish; postnotal mediotergite pale whitish yellow. Pleura yellow, with a broad dorso-longitudinal brown stripe that extends from the propleura, passing beneath the wing-root and across the pleurotergite to the abdomen; sternopleurite similarly darkened, producing a short ventral stripe. Halteres dusky, the knobs yellowish. Legs with the fore coxæ dark brown on outer face at base, forming part of the dorsal stripe; remaining coxæ and trochanters pale yellow; legs relatively long and slender, femora obscure yellow, darkened beyond base, gradually deepening to a narrow, dark brown, subterminal ring, the extreme tip again abruptly yellow; tibiæ obscure yellow, brightest at base, the tips darkened; tarsi brown. Wings with a creamy ground-colour, with a sparse dark pattern; stigma oval, brown; the brown clouds include conspicuous seams at Sc_2, origin of *Rs*, cord and outer end of cell 1*st* M_2; a broad diffuse seam in cell *M* adjoining vein Cu_1, becoming obsolete at mid-length of the cell; veins dark, more yellowish in the costal and prearcular regions. Costal fringe relatively short and inconspicuous. Venation: Sc_1 ends just before mid-length of *Rs*, Sc_2 longer, ending just beyond this point; *Rs* square at origin, weakly

spurred; R_2 and free tip of Sc_2 in transverse alignment; inner end of cell R_3 lying far proximad of the other cells of cord; cell 1*st* M_2 large, rectangular, as long as vein M_{1+2} beyond it; *m–cu* shortly beyond the fork of M, subequal to the distal section of Cu_1.

Abdomen bicolorous, the bases of the segments obscure yellow, the tips more narrowly dark brown. Male hypopygium with the ventro-mesal lobe of the basistyle very long and slender, gradually narrowed to an acute chitinized point. Dististyle complex, trilobed; what seems to correspond to the usual dorsal dististyle a short, nearly straight, pale rod, the apex narrowed and blackened; main body of ventral dististyle a small fleshy lobe; third branch corresponding to the rostral prolongation, this elongate, feebly chitinized, strongly curved at end, without rostral spines.

Hab. South Queensland.

Holotype, ♂, Mt. Tamborine, altitude 2000 feet, June 17, 1928 (*W. H. Davidson*).

Limonia (*Limonia*) *exosa*, sp. n.

General coloration of mesonotal præscutum yellow, with a brown median stripe; posterior sclerites of mesonotum dark brown; anterior vertex silvery; antennæ relatively long, black; wings with a distinct dusky tinge; *Sc* long; cell M_2 open by the atrophy of the basal section of M_3; *m–cu* at fork of M; male hypopygium with the dorsal dististyle lacking; ventral dististyle small, produced into a long arcuated chitinized blade.

Male.—Length about 3·6 mm.; wing 4·5 mm.

Rostrum brownish yellow; palpi brown. Antennæ dark brown throughout, of an unusual length for a member of this genus, if bent backward extending at least to the base of the abdomen; flagellar segments long-oval, with a short, dark, glabrous, apical pedicel; segments clothed with a dense white pubescence and short scattered verticils, the longest unilaterally arranged. Anterior vertex light silvery; posterior portion of vertex dark brown, the posterior orbits light grey.

Pronotum brownish black. Mesonotal præscutum yellowish, with a broad brown median stripe that widens behind; posterior sclerites of mesonotum dark brown. Pleura dark brown dorsally, the ventral portion paler. Halteres relatively long, dark brown, the base of the stem narrowly pale. Legs with the coxæ and trochanters yellowish testaceous; femora light brown, the bases narrowly yellowish; tibiæ

pale brown; tarsi somewhat darker brown. Wings with a distinct dusky tinge, the oval stigma barely darker; veins brown, with relatively long, conspicuous, brown macrotrichia. Venation: Sc relatively long, Sc_1 extending to beyond mid-length of Rs, Sc_2 close to its tip; Rs weakly angulated at origin; free tip of Sc_2 and R_2 pale, the latter lying slightly more distad than the former; cell M_2 open by the atrophy of the basal section of M_3; m–cu at fork of M, a trifle shorter than the distal section of Cu_1; vein *2nd A* relatively elongate.

Abdomen dark brown, the eighth segment and hypopygium paler. Male hypopygium with the tergite strongly narrowed posteriorly, the caudal margin with a very low V-shaped notch. Ventro-mesal lobe of basistyle very large but low, applied to the whole mesal face of the style. Ventral distisyle small, oval, produced into a long arcuated chitinized blade. Dorsal dististyle lacking. Ædeagus very short and broad, the apex divided into two obtuse divergent lobes. Gonapophyses broad, the mesal apical angle produced into a long arcuated lobe that is gently widened outwardly, the tip obtuse.

Hab. New South Wales.

Holotype, ♂, Brooklana, Eastern Dorrigo, altitude 2000 feet, November 6, 1927 (*W. Heron*).

Paratopotypes, 6 ♂ ♂, February 1928 (*W. Heron*).

Limonia exosa is similar to *L. amicula* (Alexander) of North Queensland, differing in the diagnostic features given above.

Limonia (*Libnotes*) *tayloriana*, sp. n.

General coloration pale reddish yellow, the mesothorax unmarked with darker; head light grey; halteres and legs pale testaceous-yellow; wings subhyaline, the stigma subcircular, dark brown; veins pale, the cord and outer end of cell *1st* M_2 darker; male hypopygium with the spines of the rostral prolongation of the ventral dististyle very unequal in diameter.

Male.—Length about 5·5 mm.; wing 6 mm.

Rostrum moderately elongate, nearly as long as the remainder of head, pale brown; palpi obscure brownish yellow, 4-segmented. Antennæ dark brown; flagellar segments elongate-oval, each with a pair of outstanding verticils that are unilaterally arranged, these exceeding the segments in length. Head entirely light grey; eyes large, contiguous on vertex or virtually so.

Prothorax and mesothorax pale reddish yellow, entirely immaculate with darker; a whitish median line extends from the cephalic portion of the præscutum to the abdomen, widening out behind. Halteres short, pale. Legs pale testaceous-yellow, only the outer tarsal segments slightly darkened. Wings subhyaline, the base and costal region more yellowish; stigma small, nearly circular in outline, dark brown; veins pale yellow, the cord between the forks of *Rs* and *M* darkened; outer end of cell 1*st* M_2 darkened; this dark coloration involves only the veins. Venation: *Sc* very long, Sc_1 extending to opposite *m–cu*; free tip of Sc_2 and R_2 in alignment; *Rs* about three times the basal section of R_{4+5}; cell 1*st* M_2 elongate, the elements at outer end about in transverse alignment; *m–cu* at about two-fifths the length of cell 1*st* M_2, subequal to the distal section of Cu_1; vein *2nd A* approaching 1*st A* on the prearcular portion, thence gently sinuous and divergent.

Abdomen reddish yellow, the caudal margins of the segments narrowly and vaguely paler. Male hypopygium with the ninth tergite transversely rectangular, the caudal margin with a broad V-shaped notch, the lateral lobes with coarse conspicuous marginal setæ. Basistyle of moderate size, the mesal lobe low and obtuse. Ventral dististyle very large and fleshy, much larger than the basistyle; rostral prolongation relatively slender, with two spines that are very unequal in size, the outer spine placed just beyond mid-length of the prolongation, powerful and gently curved; inner spine near base of prolongation, very small and weak, setiform. Dorsal dististyle a curved chitinized rod, the apex acute. Ædeagus elongate, the apex with divergent flaps. Gonapophyses with the mesal apical angle long, slender, gently curved, the tip obtuse, the lateral margin with scattered pale spiculæ.

Hab. North Queensland.

Holotype, ♂, Mossman, March 1927 (*F. H. Taylor*).

Type in the Australian Institute of Tropical Medicine.

I take great pleasure in naming this species in honour of Mr. Frank H. Taylor, authority on the biting-flies of Australia. The fly is amply distinct from other regional species of *Libnotes*.

Limonia (*Dicranomyia*) *dicksoniæ*, sp. n.

General coloration brownish grey, the pleura clear blue-grey; antennæ black throughout; mesonotal præscutum with brown stripes, the median one more shiny black anteriorly; knobs of halteres infuscated; legs chiefly black;

wings grey, almost unmarked except for the stigma; *Rs* elongate, gently arcuate; male hypopygium with the tergite deeply emarginate medially.

Male.—Length about 6 mm.; wing 7 mm.

Female.—Length about 6·5 mm.; wing 8–8·2 mm.

Rostrum grey; palpi dark brown. Antennæ black throughout; basal flagellar segments subglobular, the outer segments passing to oval. Head light grey, the posterior vertex with a triangular dusky area on either side of a linear ashy median stripe; anterior vertex blue-grey, of moderate width.

Mesonotal præscutum dull yellowish grey, with three brown stripes, the median stripe more shiny black, especially in front; lateral stripes sometimes obsolete; posterior region of præscutum more brownish grey; scutal lobes brownish, the remainder of mesonotum clearer grey. Pleura clear blue-grey. Halteres of moderate length, pale, the knobs infuscated. Legs with the coxæ grey; trochanters brownish yellow; femora brown, the tips passing into dark brown or black; tibiæ and tarsi black. Wings relatively narrow, grey, the stigma oval, pale brown; scarcely indicated darkenings on other veins; cord and outer end of cell 1*st* M_2 with extensive obliterative areas; veins dark brown. Venation: Sc_1 ending shortly before or beyond the origin of *Rs*, Sc_2 some distance before this tip; Sc_1 variable in length, from nearly as long as *m–cu* to considerably longer (♂); *Rs* long, gently arcuated, about twice the basal section of R_{4+5}; R_2 in approximate alignment with the free tip of Sc_2; *m–cu* shortly before the fork of *M*, usually from one-third to one-fourth its length.

Abdomen black, heavily pruinose, the hypopygium chiefly dark or obscure. Male hypopygium with the tergite large, the caudal margin deeply notched, the lateral lobes conspicuous, bordered with conspicuous setæ; a small transverse oval area on mid-length of tergite near caudal margin, this provided with two long and two more delicate setæ. Basistyle relatively large, the ventro-mesal lobe at its base, long and relatively narrow, provided with several stout flattened setæ in addition to smaller ones; at the base of this lobe a small tubercle set with about six long curved setæ. Ventral dististyle relatively small, fleshy, the rostral prolongation of moderate size, blackened, terminating in a small, chitinized, beak-like point; spines two, placed on the face of the prolongation at near mid-length, the inner spine a little longer and straighter than the slightly curved outer spine. Dorsal dististyle a gently curved rod that is narrowed at tip into a

long spine. Ædeagus broad, trifid at apex. Ovipositor with the basal shields and valves fulvous-brown; tergal valves slender, gently upcurved, relatively small, but still much larger than in *whitei*.

Hab. Victoria.

Holotype, ♂, Ferntree Gully, April 15, 1928 (*F. E. Wilson*).

Allotopotype, ♀.

Paratype, ♀, Ringwood, May 5, 1928 (*F. E. Wilson*).

Type returned to Mr. Wilson.

Limonia dicksoniæ is generally similar to *L.* (*D.*) *whitei* (Alexander) of Victoria and Tasmania, but it is very distinct in the diagnostic features listed above. It likewise resembles *L.* (*D.*) *helmsi* (Skuse), but differs in the details of venation, as the long, gently arcuated *Rs*.

Limonia (*Dicranomyia*) *dorrigensis*, sp. n.

Belongs to the *liberta* (*tristis*) group; allied to *illingworthi*; size very small (wing, ♂, about 4 mm.); wings greyish, unmarked except for the stigma; male hypopygium with the gonapophyses very broad.

Male.—Length about 3·2 mm.; wing 4·1 mm.

Rostrum, palpi, and antennæ black; flagellar segments oval. Head dark grey.

Mesonotal præscutum yellowish grey, with three brown stripes; scutal lobes darkened; remainder of mesonotum more brownish grey. Pleura dark greyish brown. Halteres yellow, the knobs infuscated. Legs with the fore and middle coxæ extensively dark brown, the hind coxæ chiefly obscure yellow; trochanters reddish; remainder of legs brown, the tarsal segments passing into dark brown. Wings greyish, the oval stigma a little darker than the ground-colour; veins dark brown. Venation: Sc_1 ending about opposite the origin of *Rs*, the latter nearly three times the basal section of R_{4+5}; cell 1*st* M_2 elongate, longer than the veins issuing from it; *m–cu* more than one-half its length before the fork of *M*.

Abdominal tergites dark brown, the sternites more yellowish; hypopygium brownish yellow. Male hypopygium with the tergite transverse, the caudal margin evenly and convexly rounded, with a marginal series of setæ, including a median pair that are longer and stouter. Basistyle relatively small, the ventro-mesal lobe very stout, terminating in a dense brush of setæ; on face of style a small finger-like lobe that is tufted with setæ that are considerably longer

than the lobe itself; a small group of three or four strong setæ near the apical mesal portion of the basistyle. Dorsal dististyle a gently curved rod that is slightly expanded on outer half, thence gradually narrowed to a long apical spine. Ventral dististyle fleshy, including the broad rostral prolongation; the two rostral spines placed side by side, subequal in length, arising from low tubercles. Gonapophyses with the mesal apical lobe very broad, the outer margin weakly toothed, the lobe merging gradually with the main body of the apophysis.

Hab. New South Wales.

Holotype, ♂, Brooklana, Eastern Dorrigo, altitude about 2000 feet, February 10, 1929 (*W. Heron*).

Limonia dorrigensis is allied to *L.* (*D.*) *illingworthi* (Alexander), differing most evidently in the small size, wing-pattern, and structure of the male hypopygium, especially of the gonapophyses.

Limonia (*Dicranomyia*) *flavidella*, sp. n.

General coloration pale yellow; legs long and slender, the terminal tarsal segments darkened; wings pale yellow, the stigma vaguely darker; costal fringe relatively long and conspicuous; cell M_2 open by the atrophy of *m*.

Male.—Length about 5 mm.; wing 6 mm.

Rostrum and palpi pale yellow. Antennæ broken. Head ochreous-yellow.

Mesonotum and pleura uniformly reddish yellow, without markings. Halteres of moderate length only, pale yellow throughout. Legs long and slender, pale yellow, only the terminal tarsal segments infuscated; claws simple, except for a basal spine. Wings uniformly pale yellow, the stigma vaguely darker; veins darker yellow. Costal fringe relatively long and conspicuous. Venation: *Sc* short, Sc_1 ending opposite the origin of *Rs*, Sc_2 a short distance from its tip, Sc_1 alone about one-half the length of *Rs*; *Rs* about one-third to one-fourth longer than the basal section of R_{4+5}; cell M_2 open by the atrophy of *m*; *m–cu* at or shortly before the fork of *M*; distal section of Cu_1 a little shorter than *m–cu*.

Abdomen uniformly ochreous-yellow. Male hypopygium with the ninth tergite transverse, the caudal margin virtually straight across, each lateral angle with about a dozen setigerous punctures. Basistyle relatively short and stout, the ventro-mesal lobe large, conspicuously setiferous. Ventral dististyle large and fleshy, much larger than the

basistyle, the rostral prolongation relatively slender, with two conspicuous spines; outer spine about three-fourths the length of the inner, placed a little more than one-half its length from the tip of the prolongation; spines placed close together. Dorsal dististyle a strongly curved hook, the long slender apex blackened. Gonapophyses very extensive, pale, the mesal apical angle curved to the obtuse tip. Ædeagus bifid at tip.

Hab. Victoria, New South Wales.

Holotype, ♂, Millgrove, Victoria, altitude about 1600–1700 feet, in a deeply shaded fern-gully, April 7, 1928 (*F. E. Wilson*).

Paratype, ♂, Eastern Dorrigo, New South Wales, altitude 2000–3000 feet, February 27, 1929 (*W. Heron*). "Beaten from tree-fern foliage, *Dicksonia antarctica*" (*F. E. Wilson*).

Type returned to Mr. Wilson.

Limonia (*Idioglochina*) *perkinsiana*, sp. n.

Allied to *tusitala*, Alexander; general coloration dark brownish grey; mesonotal præscutum brown, with four dark brown stripes; pleura dark brownish grey; legs dark brown, including the coxæ; wings with a strong dusky tinge; male hypopygium with the caudal margin of the ninth tergite bearing a small, deep, V-shaped median notch.

Male.—Length about 6 mm.; wing 7·5 mm.

Rostrum dark brown, nearly as long as the remainder of the head; palpi dark brown. Antennæ dark brown, the first segment more pruinose; flagellar segments strongly produced beneath, as in the *tusitala* group, the apical necks short and stout. Head pale reddish brown, sparsely pruinose, the median region of the vertex more infuscated.

Mesonotal præscutum with the interspaces brown, the disk with four dark brown stripes, the lateral and posterior portions of the sclerite dark greyish plumbeous; pseudosutural foveæ punctiform, dark brown; scutum light grey medially, each lobe with two dark brown areas; scutellum and postnotum light grey. Pleura dark brownish grey, the dorso-pleural membrane buffy. Halteres obscure yellow. Legs with the coxæ dark brown, pruinose, the apices restrictedly pale; remainder of legs dark brown, the femoral bases only a trifle brighter; claws with a series of about four teeth, the outermost longest. Wings with a strong dusky tinge, *Rs* and *Cu* more suffused with still darker brown; veins yellowish brown, some darker brown. Venation: *Sc*

relatively long, the distance on costa between Sc_1 and origin of *Rs* about two-thirds the length of the latter; basal section of R_{4+5} about two-thirds *Rs*; R_{2+3} only gently arcuated; *m–cu* shortly beyond the fork of *M*.

Abdominal segments dark brown, the tergites vaguely more reddish brown medially at base; caudal margins of the segments very restrictedly pale; sternites obscure brownish yellow, darker laterally, the caudal margins narrowly pale; hypopygium more brightened. Male hypopygium with the caudal margin of the ninth tergite with a small but deep V-shaped median notch. Dorsal dististyle strongly curved, sickle-shaped, narrowed to the subacute apex. Ventral dististyle with the inner beak-like portion stout, the tip obtuse.

Hab. Queensland.

Holotype, ♂, Dunk Is., August 25, 1927 (*F. A. Perkins*).

I name this crane-fly in honour of the collector, Mr. F. A. Perkins.

Type in the University of Queensland.

Limonia perkinsiana is allied to *L.* (*I.*) *vilæ* (Edwards) and *L.* (*I.*) *novocaledonica*, Alexander, differing from both in the very dark colour and details of structure of the male hypopygium.

Eurhamphidia invenustipes, sp. n.

General coloration brownish grey; legs uniformly darkened; wings subhyaline, iridescent, the stigma and apex darkened.

Male.—Length about 6–6·3 mm.; wing 6·4–6·8 mm.

Rostrum approximately as long as the remainder of head, dark brown; palpi black. Antennæ short, brownish black, the first segment obscure yellow at base. Head brownish grey.

Pronotum dark brown. Mesonotal præscutum yellowish brown, with a narrow but conspicuous dark brown median stripe that does not extend to the suture; scutum pale brown, the centres of the lobes brownish black; scutellum and postnotum light brown. Pleura pale brown, pruinose, darkened dorsally; dorso-pleural membrane obscure buffy brown; sternopleurite darker brown. Halteres slender, dark brown, the base of the stem restrictedly obscure yellow. Legs long and slender; coxæ obscure yellow, the fore coxæ more infuscated; trochanters obscure yellow; femora brown; remainder of legs brown, without white markings. Wings highly iridescent, subhyaline; stigma elongate, dark

brown; wing-apex narrowly darkened; veins dark brown. Venation: Sc_1 ending nearly opposite *r–m* or somewhat beyond it, Sc_2 not far from its tip; first section of *Rs* nearly twice the second; veins R_2 and R_{4+5} divergent apically; *m–cu* at near mid-length of cell 1*st* M_2, in approximate alignment with *r–m*.

Abdomen relatively long and slender, brownish black, the basal sternites obscure yellow.

Hab. West Australia.

Holotype, ♂, Donnybrook, August 29, 1926 (*E. W. Ferguson*).

Paratype, ♂, Pemberton, August 28, 1926 (*E. W. Ferguson*).

Type in the Macleay Collection.

Eurhamphidia invenustipes is entirely different from *E. niveitarsis* (Skuse), the only other described Australian species.

XI.—*Descriptions and Records of Bees.*—CXXII. By T. D. A. Cockerell, University of Colorado.

Bombus discrepans, Pendlebury.

3 ♂, Koo Luang, Nakawn Sritamarat, Siam, April 30, 1928 (*Kerr*).

The genitalia, which differ considerably from those of any species known to me, were not described by Pendlebury. Spatha strap-shaped, parallel-sided, acutely pointed at apex; sagitta stout, very obliquely truncate apically, with the lower (outer) corner produced into a sort of short beak; stripes very broad at base, apically broadly truncate, for the attachment of the squama; squama black, somewhat U-shaped, with very thick base, outer arm broadly attached to stipes, but not projecting, inner much shorter, and pointed; volsella extending finger-like far beyond squama, the apex obtuse, somewhat broadened, its inner margin concave; stiff bristles project from beneath the apical portion.

The specimens were taken at an altitude of 1400 to 1600 m.

In its general appearance this bee is exactly like *B. ignitus*, Sm., from Japan.

Trigona ambusta, Cockerell.

Siam; Koh Po, Pattani, April 5; many from nest in hollow tree (*Kerr*).

The mesothorax and tegulæ are considerably darker than in the type. New to Siam.

Trigona bakeri, Cockerell.

Siam; Tung Nui, Satul, at flowers of *Melastoma malabaricum*, March 19 (*A. F. G. Kerr*).

The red spots at extreme base of antennæ are very obscure. New to Siam.

Trigona biroi, Friese.

Taken by Dr. Kerr at the same time, place, and flowers as *T. bakeri*. New to Siam; it is common in the Philippine Is. The abdomen is perfectly black.

Trigona atomella, Cockerell.

Siam; Chun Het, Trang (*Kerr*).
"Taken on my own hands, April 15."

Trigona heideri, Friese.

British Guiana; Amatuk, May 24 (*J. Ogilvie*).

Trigona longipes, Smith.

British Guiana; Amatuk, Kangaruma, and Tumatumari (*J. Ogilvie*).

Trigona clavipes (Fabricius).

British Guiana; Rockstone, June 2 (*A. Mackie*).

Melipona interrupta oblitescens, Cockerell.

British Guiana; Kaieteur, May 27 (*A. Mackie*).

Melipona fasciata barticensis, Cockerell.

British Guiana; Kaieteur, May 27 (*A. Mackie*).

Augochlora (*Pseudaugochloropsis*) *ogilviei*, sp. n.

♀.—Length about or nearly 7 mm., anterior wing 5·5 mm. Robust, very bright yellowish green, shining, the abdominal tergites very broadly margined with black; hair of head and thorax scanty, dull white, abundant on sides of face; scutellum with long black hairs, and an

admixture of short black hairs on mesothorax; mandibles reddened apically; face broad; clypeus black except upper margin; supraclypeal area black; middle of face elevated, forming an obtuse ridge; front shining, with a strong median groove; ocelli rather large; flagellum dull rufous beneath except basally; angles of prothorax obtuse; mesothorax highly polished, appearing impunctate under a lens, but the microscope shows minute piliferous punctures; scutellum polished like mesothorax, and also the large area of metathorax, which has no radiating plicæ, but under the microscope shows an excessively fine transverse lineolation, tending toward reticulation; tegulæ dark reddish. Wings dusky, nervures and stigma dark brown; second cubital cell extremely high and narrow; first recurrent nervure meeting second intercubitus. Legs black, with pale hair, small joints of tarsi rufescent, anterior legs obscurely rufescent in front; hind spur with five long dark sharp spines. Underside of abdomen obscurely reddish.

Five from Rockstone, British Guiana, June 2 (*J. Ogilvie*, *A. Mackie*).

In Vachal's table this runs to *A. elachion* (Vachal), from Honduras, but differs at once in the sculpture and the nonmetallic legs. It is a distinct and easily recognized species.

Augochlora phanerorhina, sp. n.

♂.—Length 7·5–8·5 mm., anterior wing 5 mm.

Very bright emerald-green, the hind part of thorax more yellowish green, hind margins of abdominal tergites very broadly black; hair of head and thorax extremely scanty, pure white on cheeks, but vertex, scutellum, and postscutellum with dark plumose hairs; eyes deeply emarginate; face narrow, clypeal region strongly produced, forming a thick snout, the clypeus convex, polished, with very strong close punctures, the apical margin narrowly black; labrum and mandibles reddish; supraclypeal area densely punctured; front dull; flagellum short for a male, obscurely reddened beneath; mesothorax shining, strongly and closely punctured, at each side anteriorly dull from the density of the punctures; scutellum strongly punctured; angles of prothorax very prominent and sharp; area of metathorax shining, with strong radiating plicæ, but no well-defined polished margin, its width (antero-posteriorly) in middle a little less than that of the large postscutellum, the hind margins of both angulate; tegulæ very dark reddish brown. Wings dusky hyaline, the rather small stigma sepia, nervures dark brown; second

cubital cell rather narrow, especially above; first recurrent nervure meeting second intercubitus. Legs largely black, with pale hair, but anterior femora behind, middle femora beneath, and hind coxæ bright green, anterior tibiæ ferruginous in front, tarsi more or less reddish. Abdomen shining, with sericeous white tomentum; venter black, not modified, except that the margin of the second sternite is obtusely angulate in middle.

British Guiana; type and one other from Amatuk, May 24 (*J. Ogilvie*); one from Waratuk, May 24 (*J. Ogilvie*).

Very near to *A. esox*, Vachal, but distinguished by the black margin of clypeus. Probably Vachal's *A. esox* was composite, and the specimen cited from British Guiana may have been this species. I will designate Cuzco, Peru, as the type-locality, as Peru was the only country from which Vachal had both sexes of the typical form. In Schrottky's table of "Oxystoglossæ" with hind margins of tergites black, our insect runs to the couplet including *A. iheringi*, Ckll., and *A. feronia*, Smith, but it is not very close to these.

Augochlora (*Augochloropsis*) *cataractæ*, sp. n.

♂.—Length nearly 10 mm., anterior wing 7 mm.

Bright emerald-green, the convex shining supraclypeal area blue-green, abruptly contrasting with the golden suffusion of sides of face; abdomen rather bluish green, with the depressed hind margin of second tergite (about twice as long as that of first) golden green; tegulæ large, entirely green; legs green as far as the basal part of basitarsi (more than half of hind basitarsi), beyond that black, the apical joint of front legs rufescent; hair of head and thorax tinged with fulvous, but white on cheeks and under side of thorax; an admixture of dark hairs on head and thorax above; head broad, orbits very strongly converging below; clypeus convex, very coarsely and densely rugoso-punctate, the apical margin very narrowly black; mandibles (which are simple) and labrum black; process of labrum very broadly and deeply emarginate; tongue dagger-like, not very long; antennæ black; angles of prothorax very broad, not prominent; mesothorax very densely and coarsely rugoso-punctate; scutellum also roughened, but anteriorly shining, in contrast with the adjacent mesothorax; area of metathorax smooth and shining, with very delicate weak radiating plicæ at sides; metathorax behind enclosure rough. Wings hyaline; stigma small, pale greyish brown; second cubital cell higher than broad; first recurrent nervure meeting second intercubitus,

a little on the outer side. Abdomen shining, but finely rugulose, first two tergites regularly vibrissate, the bristles dark brown; tergites beyond the first with a thin clothing of black hairs; apex with at each side a tuft of very long reddish hairs; venter with the first three segments bright green with black margins, fourth brownish black with two green patches.

Kaieteur, British Guiana, May 27, 1929 (*Alice Mackie*).

The specific name recalls the falls, which have a height of 800 feet. In Vachal's table this runs near to *A. rudis* (Vachal), and must be closely allied, differing by the mainly green basitarsi and the measurements (wing 9 mm. in *A. rudis*). In Schrottky's Brazilian table it runs to *A. electra*, Sm., but that has yellow tarsi. It is somewhat allied to the differently coloured *A. heterochroa*, Ckll.

Augochlora (*Augochloropsis*) *semitoralis*, sp. n.

♀ (type).—Length about 6 mm., anterior wing 5·3 mm.

Robust, brilliant shining emerald-green, more or less golden at base of antennæ and along orbits, golden at extreme sides of base of area of metathorax and along hind margin of first tergite; or the inner orbital margins may be without golden, or the region near the base of antennæ may show coppery red; femora green, the hind femora very dark brown, not metallic, posteriorly; tarsi very dark brown, not at all metallic, except the hind basitarsi slightly at base in front; hair of head and thorax very seanty, pale, with an admixture of dark hairs dorsally; hind tarsi with copious pale ferruginous hair on inner side; vibrissæ (same in both sexes) weak and rather irregular, the bristles tinged with orange; head broad, orbits strongly converging below; apical middle (but not sides) of clypeus broadly black; labrum and the bidentate mandibles black; a brilliant green spot at base of mandibles; antennæ black; prothorax laterally rounded, not angulate; disc of mesothorax brilliantly shining, with well-separated punctures, but sides extremely densely punctured; scutellum shining, with well-separated punctures; area of metathorax with a narrow curved channel, regularly crossed by strong plicæ, the broad rounded margin highly polished; tegulæ green basally, dark red outwardly, the whole effect very dark. Wings hyaline, faintly dusky; stigma dilute greyish brown; nervures fuscous, the costal nervure dark brown; second cubital cell broad, not far from square; first recurrent nervure meeting second intercubitus or going slightly beyond. Abdomen broad, shining, the

hind margins of tergites with a slight effect of thin hair-bands. Hind spur with seven extremely long slender black spines, tipped with reddish.

♂.—Similar, except for the usual sexual differences; clypeus prominent, with a broad dull white apical band; labrum and mandibles rufous, the extreme base of mandibles green; antennæ black, but the third joint somewhat swollen and red (compare the much larger *A. callichroa*, Ckll.); legs green, with knees, tibiæ obscurely at extreme apex, and the tarsi light ferruginous; venter of abdomen not modified, the first three sternites green.

5 ♀, Amatuk, British Guiana, May 24 (*J. Ogilvie*); 1 ♂, Kaieteur, May 26 (*A. Mackie*).

This little bee is very close to *A. toralis*, Vachal, but appears to differ, especially by the dark tegulæ and costal nervure of the female. Schrottky states that *A. toralis* is a synonym of *A. calypso*, Sm., and while our species is very close to *A. calypso*, it is certainly distinct by the orbits not edged with blue, the vibrissæ not conspicuous, and the wings not yellowish. *A. toralis* is said to range from Mexico to Bahia and Pará in Brazil, and it is very likely that the series is composite. Its spur is not described by Vachal. Perhaps the Brazilian specimens were *A. calypso*, and those from British Guiana *A. semitoralis*. It is greatly to be desired that someone having access to Vachal's collection in Paris should designate holotypes and type-localities, and inform us when the series contains a mixture of species.

Halictus potaroënsis, sp. n.

♀ (type).—Length fully 5 mm., anterior wing 4 mm.

Head and thorax nearly black, but with a perceptible metallic tint, the upper part of clypeus and sides of face dark green, supraclypeal area rosy red, cheeks green, vertex dark steel-blue, mesothorax and scutellum obscurely bluish, the scutellum slightly purplish, metathorax and pleura dark green; abdomen black, with the hind margins of the tergites rufescent; hair very scanty. Head rather oblong, with the clypeus prominent; mandibles dark, faintly reddened about the middle; clypeus shining, the apical portion black; inner orbits concave; front dull, very densely and minutely punctured (not striate); prothoracic angles prominent, rectangular; tubercles prominent, pointed; mesothorax shining, the surface microscopically tessellate, with scattered very minute punctures; scutellum moderately shining; area

of metathorax large, the apical portion smooth and shining, the base minutely plicatulate; tegulæ very dark rufous, sparsely and weakly but evidently punctured (same in both sexes). Wings brownish hyaline, stigma large, very dilute brown, nervures fuscous, outer recurrent and intercubitus very weak; second cubital cell broader below than above, its lower side strongly oblique, receiving recurrent nervure a short distance before end. Legs black, with the tarsi and base of hind tibiæ dull ferruginous; hind spur with three long spines. Abdomen shining, thinly hairy, with a tendency to bands at sides of tergites 2 to 4.

♂.—Similar, except for the sexual characters; clypeus with a broad apical rufo-testaceous band; labrum red; mandibles mainly reddish; mesothorax shining dark green; hind knees, apex of their tibiæ, and the tarsi pale testaceous; antennæ only moderately long for a male, the flagellum pale testaceous or clay-colour beneath.

Kaieteur, British Guiana, May 27, 1929 (*Alice Mackie*).

Belongs to the subgenus *Chloralictus*, and is related to a series of Neotropical forms which are doubtless far more numerous than the present records show. *H. semiviridis*, Friese, from Bermuda, is smaller and less robust, with shorter face. *H. exiguiformis*, Ellis, from Guayaquil, has a much shorter and broader head and olive-green mesothorax. I do not find any species near enough to cause confusion.

Sphecodes biroi mariæ, subsp. n.

♂.—Length about 7 mm., anterior wing 6·3 mm.

General characters of *S. biroi*, Friese, with very broad face, covered with white hair, hairy eyes, no pubescent bands on flagellar joints, flagellum strongly nodose beneath; wings brownish, pale basally; first three abdominal tergites mainly red. Mandibles red in middle; flagellum entirely dark; tegulæ very dark, obscurely reddish externally; hind wings with eight hooks; first tergite with a broad hemispherical black patch, second blackened in middle, especially apically, third red only at base; tarsi brownish black, red only at apex.

Compared with the Philippine Is. *S. latifrons*, Ckll., it is seen to be very closely allied, but larger and more robust, with dark tegulæ, and base of metathorax more densely sculptured. The second and third tergites are more strongly and closely punctured than in *S. latifrons*. *S. abnormis*, Perkins, has testaceous tarsi and presents a

number of other small differences. *S. dutti*, Blüthg., is also evidently different.

Siam ; Nan, Jan. 8, 1928 (*Cockerell*).

Named after Dr. Mary Collier, who collected many insects at Nan. The group of *S. biroi* cannot be fully elucidated at present. Blüthgen (1927) combines all the different forms (with a query in respect to *S. dutti*) under the specific name *S. biroi*, originally based on an insect from New Guinea. This seems to be going too far, though it is useful to call attention to the close alliance. I treat the Siamese insect as a subspecies, but suppose that eventually a series of closely allied species will be recognized.

Habropoda sutepensis, Cockerell.

Described from the male. The female, from the same locality (Doi Sutep, Siam), is similar, but larger and more robust, the dense hair of the abdomen very red. Clypeus convex, the upper third in middle with a shining keel, from the lower end of which starts a creamy-white vertical band, rapidly broadening below to form a broadly triangular pale area ; labrum reddish ; mandibles with more than the basal half pale rufous ; malar space well developed ; outer side of hind tibiæ with rich copper-red hair ; hind basitarsi with black hair. The cheeks below have long pure white hair.

Osmia pseudamala, Cockerell.

Described from the male. Mr. R. Betensky has found both sexes at White Rocks, Boulder, Colorado, nesting in an old log. The female is somewhat over 10 mm. long, robust, steel-blue, with the front, vertex, occiput, mesothorax, and scutellum green ; mandibles tridentate ; hair of head and thorax above pale fulvous-tinted, mixed with black ; tegulæ half green. Legs black, hind femora green in front ; ventral scopa black. In my table (Univ. of Colo. Studies, 1928) it runs nearest to *O. albolateralis*, Ckll., though the mesopleura has black hair on the upper posterior part, or may have it mostly black, in which case it runs to *O. malina*, Ckll. *O. albolateralis* has much longer and more conspicuous black hair on clypeus. *O. malina* is 9 mm. long, with hair of scutellum mainly black, and several other differences. Miss Sandhouse points out that the genitalia of *O. pseudamala* are highly distinctive, as she will describe in her revision.

XII.—*Three new Species of the Genus* Helotrephes* (*Hemiptera-Heteroptera*). By W. E. China.

The following descriptions are based on material sent for determination by Mr. G. L. R. Hancock, Assistant Government Entomologist in Uganda, and by Prof. H. B. Hungerford, of Kansas University, to whom I am indebted for the opportunity of examining the Helotrephid material discovered by him in the Amsterdam Museum.

In not a single case was a species of *Helotrephes* known from both sexes, and in only one case (*H. bouvieri* ♂) had it been possible to make dissections. Consequently the detailed structure of the female genitalia has hitherto remained unknown; so that it was extremely interesting to receive, through Prof. Hungerford, a series of specimens of both sexes. Owing, however, to paucity of material in the described species and to the absence of knowledge of the limits of variation, and considering the fact that each species probably exists in two structurally different forms (winged and wingless), it has been very difficult to decide on the identity of the Sumatran species. After much consideration and hesitation it has been decided to describe them both as new.

Helotrephes angulatus, sp. n. (Figs. 1 *a–g*; fig. 3 *d*.)

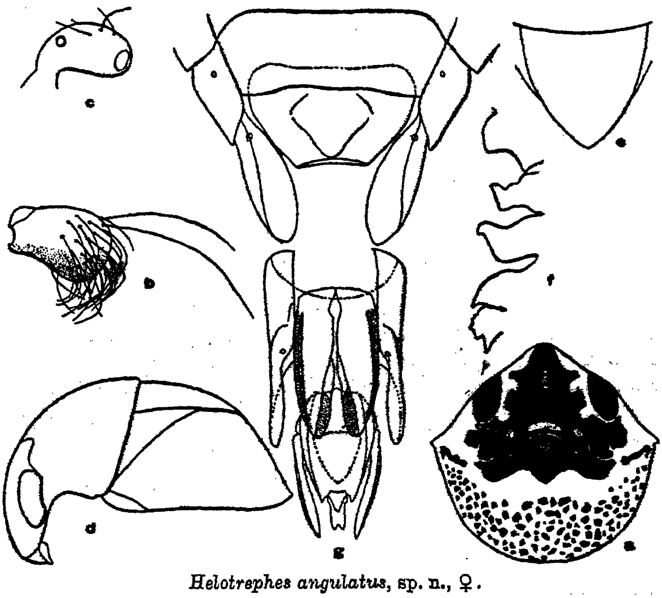
Colour (♀).—Dorsal surface pale sordid yellow marked with brownish black. Head brownish black, with an irregular-edged three-lobed border and some obscure markings on the disc and along base above the suture, pale sordid yellow (fig. 1 *a*); eyes and rostrum dark brown. Pronotum pale sordid yellow, the anterior margin along the suture brownish black, the posterior margin of this dark band strongly bisinuate, its lateral margins speckled, not reaching the lateral margins of the pronotum; posterior half of pronotum speckled with dark brown. Scutellum pale sordid yellow, moderately densely speckled with dark brown, with a large pale yellow spot at each side of base and a third in middle of base. Hemielytra pale sordid yellow, sparsely speckled with brown, the clavus and clavulus mottled with dark brown, a spot on corium at apex of clavus and the extreme apical margin of corium along interlocking device dark brown. Legs pale yellow, the coxæ, trochanters, bases of hind femora, and extreme apices of tibiæ and tarsi infuscate. Sternum and venter pale brown.

Structure (♀).—Seen in profile (fig. 1 *d*) the lateral margin of pronotum and lateral margin of head with a respective inclination of about 110°, the actual angle broadly rounded. Rostrum moderately long, extending just to the intermediate coxæ. First antennal segment (fig. 1 *c*) with its axis at right angles with the point of insertion, otherwise more or less cylindrical, with three or four scattered bristles on exposed surface, and a curious circular

* For monograph of this genus, see 'Eos,' iv. pt. 2, pp. 129–172.

organ towards its base similar to that in *Idiocoris lithophilus*; second segment slightly longer than first, wider at apex than base, rounded apically, distinctly flattened, the outer surface covered with long, strongly-curved, flattened hairs, apex with two long filiform divergent bristles (fig. 1 *b*). Pronotum with the lateral margins distinctly carinate, the carina ending abruptly before the humeral angle to form an angulated tooth (fig. 3 *d*). Scutellum about as long as broad (fig. 1 *e*). Hemielytra with distinct claval suture, the clavulus well marked; costal margin of right-hand hemielytron devoid of a lateral lobe. Wings present, whitish

Fig. 1.



Helotrephes angulatus, sp. n., ♀.

a, diagrammatic dorsal view of cephalonotum, to show colour-markings; *b*, second antennal segment; *c*, first antennal segment; *d*, profile view; *e*, scutellum; *f*, lateral view of median, sternal, and ventral carinæ; *g*, female genital segments.

hyaline, similar to those in *H. bouvieri*. Median prosternal keel strongly elevated, semihyaline, rounded anteriorly, acute-angled posteriorly, the posterior edge more or less perpendicular. Mesosternal carina strongly elevated, hyaline, wide at base, narrowed in middle, truncate at apex, which is produced anteriorly into a tooth. Metasternal carina broad, the anterior edge concave, the posterior edge short and straight, and the apex obliquely truncate, with anterior angle curved outwards and posteriorly (fig. 1 *f*). Front legs longer than the middle legs, the coxæ finely tuberculate and

covered on outer surface with long depressed hairs; femur thickest at base and tapering to apex, slightly longer than tibia (55:50), armed along inner side with longitudinal rows of short spines and longer bristles, the latter longer towards base; armed along outer side with a row of long semidepressed bristles, and a pair of long divergent bristles at base; tibia also armed along inner side with rows of short spines, bristles, and pectinate bristles; tarsus less than half the length of tibia (18:51), with inner rows of bristles and the usual apical structure; claws about one-third the length of tarsus. Middle legs similar to front legs but shorter, the femur distinctly longer than tibia (55:43), the bristles along its inner side longer towards base, those along outer side much shorter, the upper surface with a number of scattered short spines; tibial bristles longer, especially towards apex; tarsus nearly half the length of tibia, the claws about one-fourth the length of tarsus. Hind legs with femur shorter than tibia (59:72), inner side with two rows of short bristles, longest on basal half; tibiæ and tarsi with the usual long swimming-hairs and bristles; tarsal segments together nearly two-thirds the length of tibia, the second segment much shorter than first (19:25); claws about one-third the length of the first segment. Median keel of second abdominal sternite, seen in profile, strongly convex anteriorly and concave posteriorly, its apex acute and directed posteriorly, median keel of third abdominal sternite with a broad serrated basal lobe and a small posteriorly directed spur-like apical lobe (fig. 1 *f*); seventh sternite short, narrowed apically, the posterior margin concave, disc with a raised median triangular lobe; pleurites of seventh segment broad and concavely foliate; female genital segments (fig. 1 *g*) much narrower and more elongate than in *Tiphotrephes*, *Limnotrephes*, *Idiocoris*, or *Paskia*, otherwise similar in general plan, the eighth sternite split into two elongate lobes, with their inner apical extremities deflexed to form thickened flap-like appendices, pleural processes of eighth segment elongate, concave; ninth tergite with two elongate lobe-like lateral processes similar to the pleural processes of the seventh and eighth segments, and with a triangular anal flap representing the tenth segment (?); ninth sternite represented by a semitubular sclerite, the apex strongly emarginate, with the apical angles acute. An elongate style-like organ, with its apex bifid and with a small triangular lobe placed ventrally at its base, possibly represents the eleventh segment.

Total length 2·83 mm. Other measurements, see *H. hancocki*, sp. n.

Habitat.—Sumatra's O. K., Medan, 20 m.

Type, 1 ♀, 13. ix. 1921; paratypes, 1 ♀, 13. ix. 1921; 1 ♀, 3. x. 1921. J. B. Corporaal (Amsterdam Museum).

Allied to the Sumatran species *H. martini*, Kirk., which it resembles in general shape of the sternal and abdominal carinæ, shape of scutellum, and relative length of cephalonotum, but differs in the presence of the strongly-developed lateral pronotal carinæ with their angulate posterior extremities, absence of a lateral costal

lobe on right-hand hemielytron of female, in the relative length of the hind tarsal segments, and in the presence of wings and a distinct claval suture.

The possibility of this species being the winged form of *H. martini* has been considered, but other details have been thought not sufficiently identical.

Helotrephes corporaali, sp. n. (Figs. 2 *a–g* ; figs. 3 *a–c*.)

Colour (♂).—Dorsal surface greyish yellow marked with dark brown. Head dark brown, the anterior lateral areas in front of eyes, a large spot on middle of inner margin of eye, a small spot posteriorly on inner margin of eye, and an obscure narrow spot in middle of anterior disc fulvous-yellow; eyes and rostrum dark brown. Pronotum greyish yellow, the anterior margin along the suture dark brown, the posterior margin of this dark band bisinuate, its edges speckled and not reaching lateral margins of pronotum; posterior half of pronotum speckled with dark brown. Scutellum pale sordid yellow densely covered with the usual subchitinous brown speckling, and a dark brown band along basal margin which extends, less intensely, on to middle of disc in the form of a triangular mark. Hemielytra similar to scutellum, with a few indistinct brown marks over claval area and towards apex of scutellum brown. Legs fulvous-yellow, the coxæ, trochanters, base of hind femur, apices of front and middle tibiæ and tarsi moderately infuscate. Sternum and venter pale greyish brown.

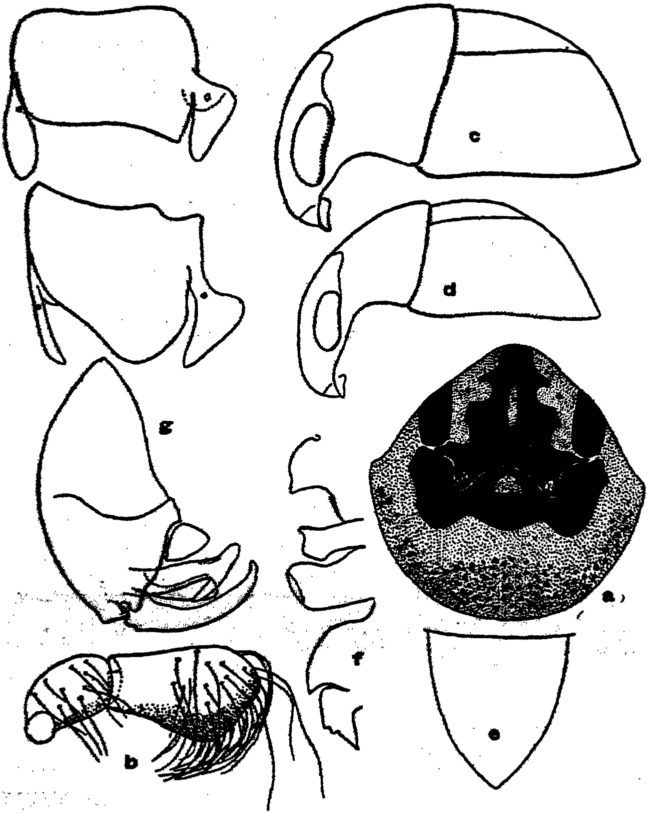
♀.—Similar to ♂, but pale markings on head more or less confluent, forming a fulvous band along lateral margin of head and inner margin of eye, with its inner border irregular in outline; an obscure, almost obsolete, fulvous-brown longitudinal stripe extends down middle of disc; pronotum as in ♂, but with a light fulvous spot in middle of brown anterior band, just below the middle of the suture; scutellum without the triangular infuscation, but with a pair of transverse dark brown spots along posterior margin of anterior brown band.

Structure (♂ ♀).—Seen in profile (figs. 2 *c* & *d*), the lateral margin of pronotum and lateral margin of head with a respective inclination of about 130° (♂) or 110° (♀), the actual angle broadly rounded. Rostrum moderately long, extending to intermediate coxæ. Antenna (fig. 2 *b*) very similar to that in *H. bouvieri*, with the second segment trapezoidal but rather less broad at the apex and longer in proportion to its width (29:16). Pronotal lateral carina percurrent, not ending abruptly as in *H. angulatus* (fig. 3 *b*). Scutellum (fig. 2 *e*) slightly longer than broad at base (33:30 ♂, 40:37 ♀). Hemielytra without claval suture or clavulus, without a lateral costal lobe in ♀, wings absent or rudimentary. Median prosternal carina seen from side similar to that in *H. angulatus*, but with the posterior angle more acute. Mesosternal carina narrow, parallel-sided at base, slightly dilated towards apex, which is truncate, the anterior angle pointed, the posterior

angle rounded. Metasternal carina broad, the anterior edge concave, the posterior edge straight, and the apex truncate; the apical extremity very thin in middle (fig. 2 *f*). Armature of legs similar to that in *H. angulatus*; relative measurements in ♂ :—

	Femur.	Tibia.	Tarsus.	Claws.
Front leg	58	52	17	5
Middle leg....................	54	40	19	7
Hind leg......................	55	64	22+18	8

Fig. 2.



Helotrephes corporaali, sp. n.

a, diagrammatic dorsal view of cephalonotum ♀, to show colour-markings; *b*, antenna of ♂; *c*, profile view of ♀; *d*, profile view of ♂; *e*, scutellum; *f*, lateral view of median, sternal, and ventral carinæ of ♂; *g*, male genital segments.

Median keels of second and third abdominal sternites, seen in profile, similar to those in *H. bouvieri*, but that of the third more sinuate along its edge (fig. 2 *f*); seventh sternite in ♀ as in *H.*

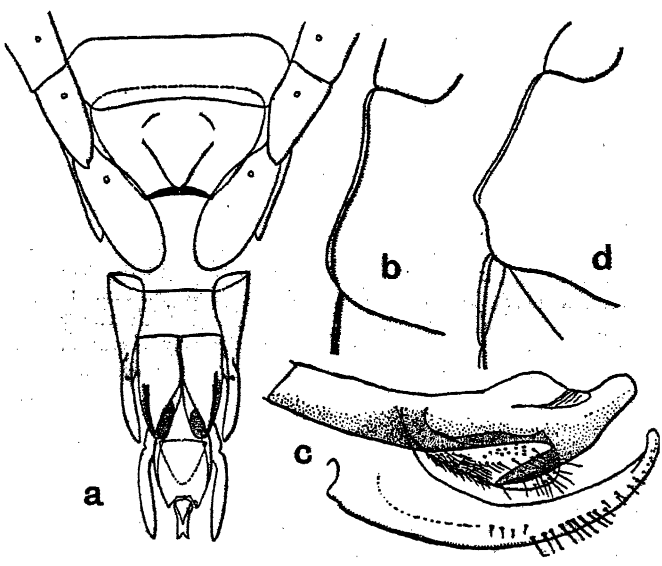
angulatus, the pleurites very broad and foliate. Genital segments in ♀ (fig. 3 *a*) very similar to those in *H. angulatus*, but the lobes of the eighth sternite much shorter. Genital segments in ♂ (fig. 2 *g*) very similar to those in *H. bouvieri*, but some slight differences in the shape of the pleurites; ventral paramere more curved at its apex, dorsal paramere more angular at its anterior apical angle, posteriorly directed barb of ædeagus relatively longer (fig. 3 *c*).

Total length, ♂ 2·67 mm., ♀ 3 mm. Other measurements, see *H. hancocki*, sp. n.

Habitat.—Sumatra's O. K., Medan, 20 m.

Type, 1 ♂, 3. x. 1921; paratypes, 2 ♂ ♂, 26. ix. 1921, and 2 ♂ ♂, 3. x. 1921, 1 ♀, 22. ix. 1921, 1 ♀, 26. ix. 1921, and 2 ♀ ♀, 3. x. 1921; also 2 larvæ, 13. ix. 1921.

Fig. 3.



Helotrephes corporaali, sp. n.—*a*, female genital segments; *b*, lateral margin of pronotum; *c*, male genitalia, showing hammer-headed ædeagus, long ventral paramere, and short dorsal paramere.
Helotrephes angulatus, sp. n.—*d*, lateral margin of pronotum, to show abbreviated carina.

Allied to *H. bouvieri* ♂ in the shape of antennæ, structure of ♂ genitalia, and in disproportionate lengths of hind tarsal segments. Differs, however, in much smaller size, shorter scutellum, and in the relative proportions of measurements CD & AD.

It is just possible that this species may be identical with *H. semiglobosus*, the length of which is given by Stål as 3 mm.

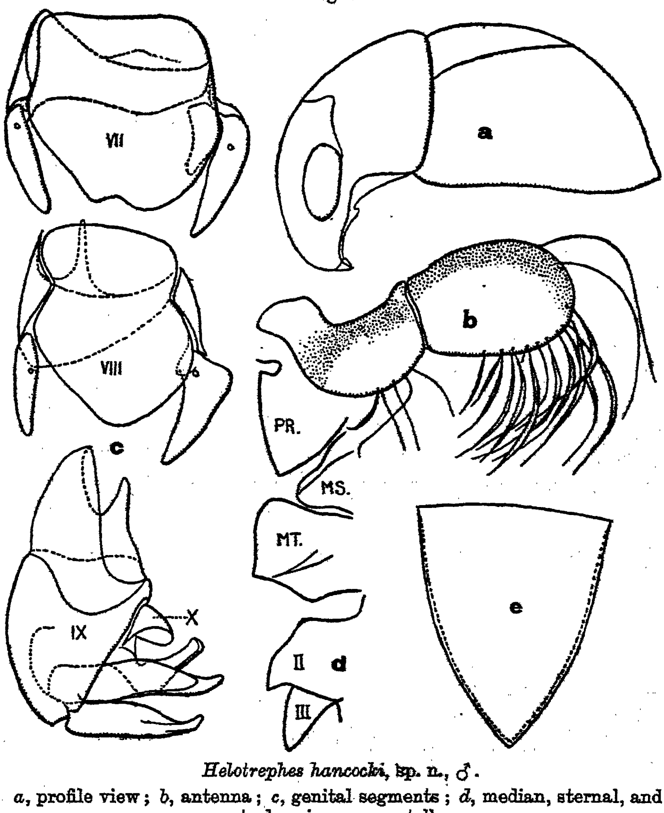
Helotrephes hancocki, sp. n. (Figs. 4 *a–e*.)

Colour (♂).—Very dark dull ferruginous-brown; eyes darker, almost black; a distinct border round eyes, a large obscure spot on each side of apex of head, a short longitudinal stripe on disc of cephalonotum just below centre of suture, posterior margin of pronotum, lateral pronotal plate, a small spot in middle of base of scutellum, a large spot on each side touching lateral margin near base of scutellum, a large obscure spot in corner of clavus between base of scutellum and posterior margin of pronotum, and a smaller spot in middle of base of corium very pale sordid yellow; scutellum paler towards extreme apex, which is obscurely pale sordid yellow; rostrum, apices of tarsi, and claws ferruginous-brown; legs brownish yellow, coxæ and basal third of hind femora dark brown.

Structure (♂).—Seen in profile (fig. 4 *a*) the lateral margin of pronotum and lateral margin of head with a respective inclination of about 110°. Rostrum moderately long, extending slightly beyond apices of anterior coxæ. Antenna (fig. 4 *b*) with the first segment curved almost at a right angle with its basal third, which is distinctly narrowed; apical half with a few long hairs; second segment longer than first, rounded and more broad apically, flattened dorso-ventrally, apical half covered with long, curved, flattened hairs, two long apical hairs less conspicuous than in *H. bouvieri* and *H. martini*; the segments in close contact, with apparently no stalk-like connection between them as in other species. Scutellum (fig. 4 *e*) much longer than broad at base (24 : 20), its apex angular. Hemielytra similar to those in *H. bouvieri*, regularly shallowly punctate, a short pale hair arising from each puncture; claval suture absent, the clavus and clavulus fused with the corium. Wings absent. Median prosternal keel strongly elevated, semi-hyaline in profile, more or less broadly lanceolate, directed posteriorly (fig. 4 *d*); mesosternal keel feebly elevated; metasternal keel strongly elevated, seen in profile very broad, anteriorly rounded, and posteriorly right-angled. Front legs longer than middle legs, the coxæ finely tuberculate and with long depressed hairs; femur thickest towards base, slightly longer than tibia, armed along inner side with longitudinal rows of short spines and longer bristles, and along outer side with a row of long semidepressed bristles, a hair at the base very long; tibiæ also armed along inner side with rows of spines, bristles, and pectinate bristles; tarsi about half the length of tibiæ, with inner rows of bristles, and with apical structure similar to that in *H. bouvieri*; claws about one-third the length of tarsus. Middle legs similar to front legs, but shorter, the femur distinctly longer than tibia (40 : 30), with the inner rows of spines and bristles becoming much longer towards base and with a number of scattered very short spines on upper surface; tibial spines longer, tarsus more than half the length of tibia (17 : 30), claws less than one-third length of tarsus; hind legs with the femur shorter than tibia (40 : 46), apical half of inside of femur with two rows of very short spines and no bristles, the femur suddenly constricted in the middle of the inner

side; tibiæ and tarsi with the usual long swimming-hairs and bristles; tarsal segments equal in length, the claws about half the length of a single segment. Abdomen with the median basal keels of second and third sternites (fig. 4 *c*) similar to those in *H. bouvieri*, but the left-hand pleural process of the seventh segment comparatively narrow, as in *Tiphotrephes*, not dilated and triangular, and the posterior margin of the seventh ventrite strongly posteriorly curved, with a concave apical sinuation, not truncate,

Fig. 4.



Helotrephes hancocki, sp. n., ♂.
a, profile view; *b*, antenna; *c*, genital segments; *d*, median, sternal, and ventral carinæ; *e*, scutellum.

as in *H. bouvieri*. Ventral paramere comparatively straight, broad, and parallel-sided for basal half, then more or less suddenly narrowed and ridged, the apex obliquely truncate. Dorsal paramere bent almost at a right angle in the middle, where it is very broad, but narrowed basally and apically, the apex shortly broadened and truncate. Ædeagus tubular, somewhat sinuate, gradually narrowed to a pointed apex, not hammer-headed as in *H. bouvieri* (fig. 4 *c*).

Total length 2 mm. Other measurements arranged as in "Monograph of Helotrephinæ" (for which see 'Eos,' iv. pt. 2, pp. 135–137).

	AB.	AD.	CD.	CE.	FK.	GH.	LM.	NO.	PQ.	T 1 : T 2.
H. angulatus ♀	83	39	38	62	42	26	61	37	36	25 : 19
H. corporaali ♂	77	37	35	54	36	23	51	33	30	22 : 17
H. corporaali ♀	87	37	39	65	44	27	64	40	37	26 : 20
H. hancocki ♂	57	24	24	40	30	19	39	24	20	16 : 16
H. hancocki ♂	60	26	27	40	30	19	39	24	20	16 : 16

Habitat.—Uganda, Kampala, Lake Victoria.

Type, ♂; paratypes, 2 ♂; and 1 larva, 30. vi. 1929 (*G. L. R. Hancock*).

Distinguished at once from all other species of *Helotrephes* by small size. Allied to *H. hungerfordi* from French Equatorial Africa, but much smaller, without a claval suture, and with the prosternal carina with its posterior angle acute. There is a remote possibility that this species may eventually prove to be the wingless male of *H. hungerfordi*. The structure of the ædeagus in *H. hancocki* is apparently not typical of that in *Helotrephes*, but until males of more species of the genus are known it is impossible to decide if this character is of subgeneric importance.

The structure of the female genitalia in the Helotrephinæ, while similar in general plan to that in the Idiocorinæ, differs in the more elongate form and in the presence of a semitubular apical abdominal segment, which may represent either the tenth or eleventh segment.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

October 23rd, 1929.—Prof. J. W. Gregory, LL.D., D.Sc., F.R.S., President, in the Chair.

The following communication was read:—

'The *Petalocrinus* Limestone Horizon at Woolhope (Herefordshire).' By Roy Woodhouse Pocock, M.Sc., F.G.S.

Upper Llandovery sandstones surmounted by Woolhope Limestone beds form the core of the Silurian anticline of Woolhope. These two groups are separated by a thickness of some 20 feet of Transition Shales with thin bands of limestone. One of these limestone-bands, averaging an inch in thickness, occurs in the Transition Beds about 5 feet from their summit, and is composed mainly of the remains of the crinoid *Petalocrinus*, which has been recorded from Sweden and North America, but has not hitherto been found in Britain.

The most striking peculiarity of the crinoid is the fusion of the arms into five solid arm-fans or petals, which radiate from the dorsal cup. The arm-fans are usually found detached in the limestone, throughout which they are profusely scattered.

A bed of large tabulate corals on which the *Petalocrinus* Band rests is found in this association throughout the outcrop. The combined thickness of the crinoid and coral-beds varies between 3 and 6 inches.

Llandovery rather than Wenlock affinities are indicated by the fauna of the Transition Beds.

Detailed mapping of the outcrop of the limestone-band has revealed interesting and unexpected features in the structure of the area, which appears to have been subjected to pressure, mainly along a north-west and south-east axis, developing thrust-faulting approximately at right angles to that axis.

Evidence is advanced in favour of a late Coal-Measure age for the principal movements that gave rise to the anticline.

At May Hill and at Malvern the *Petalocrinus* Limestone, with its associated coral-bed, has been detected at the same horizon as at Woolhope.

November 6th, 1929.—Prof. J. W. Gregory, LL.D., D.Sc., F.R.S., President, in the Chair.

The following communication was read:—

'Fossil Insects of the South Wales Coalfield.' By Herbert Bolton, D.Sc., F.R.S.E., F.G.S.

The Author describes a collection of fossil wings from the South Wales Coal Measures numbering nineteen specimens. Several are too fragmentary for determination of genus or species, or both; the remainder are referable to the Palæodictyoptera and Blattoidea.

To the first order two new species are ascribed, and to the latter ten species, the remainder being Blattoid wing-fragments too incomplete for determination.

The Palæodictyopteron wings are referred to the genus *Lithosialis*, hitherto only known from the Coal Measures of Coalbrookdale (Shropshire).

The Blattoid species are referable to the family Archimylacridæ, three species; and the tribe Hemimylacridia, seven species. The stratigraphical range of insect-remains is from the Triquart Seam of Tumble (South Wales) of Westphalian age, through the Staffordian upwards to the Penyscallen Seam of Gorseinon (Glamorgan) in the Radstockian.

Palæontologically, the insect-fauna of South Wales now shows relationships with the insect-faunas of the Midland and Northern coalfields, and a close approximation to forms already known from the Coal Measures of Coalbrookdale (Shropshire), the Forest of Dean, and those of Kent, while several of the Hemimylacridian

forms are identical with species described by Prof. Pierre Pruvost from the Coal Measures of Pas-de-Calais (Northern France).

The South Wales Coal Measure insect-fauna thus approaches more nearly to the Pas-de-Calais facies than to that of any British coalfield.

The occurrence of two species of *Lithosialis* in the South Wales coalfield links up these measures with those of the Midlands and the North of England, from which twelve families and seventeen genera are known. An intermediate link is supplied by *Lithosialis brongniarti* Mantell from the Coal Measures of Coalbrookdale (Shropshire), while *Lithomantis carbonarius* Woodward, from the Scottish Coal Measures, is a near ally.

The Welsh forms of Palæodictyoptera do not give much assistance in faunal or stratigraphical relation.

The Welsh Blattoids, however, are now sufficiently numerous and varied in character to justify comparison with the more abundant suite of forms recorded from the Coal Measures of Staffordshire and the Pas-de-Calais.

Certain species are common to both areas. *Archimylacris atrebatica* Pruvost, from the Big Vein, Cross Hands, is also found in the Assise d'Anziers, both horizons being Westphalian.

The genus *Phyloblatta* in both areas ranges from the Westphalian upwards into the Radstockian. An *Archimylacris pronotum*, from the Gwernau Level near Maes-y-Cwmmer (South Wales), is more nearly akin to the typical French species *pronotum* of this genus, figured by Prof. Pruvost, than to any British form.

It is, however, when we compare the South Wales examples of Hemimylacridia with the French species that we find the closest relation.

Hemimylacris is represented by two species from seams in the Radstockian of South Wales, comparable with two of Pruvost's species from the Faisceau d'Edouard, Assise de Bruay, which is also Radstockian. *Phylomylacris*, of which ten species are recorded in the Faisceau d'Edouard, is represented by one species from the Loughor vein; by two (possibly three) from the Penyscallen Seam of Beili Glas Colliery, Gorseinon, both in the Radstockian; and by a doubtful species in the No. 2 Rhondda Seam of the Staffordian. With the exception of this last doubtful species, *Phylomylacris* is restricted to the Radstockian in both the Welsh and the Pas-de-Calais areas. The genus *Soomylacris* presents even stronger evidence. Two new species, recorded in the paper, are from the Swansea 5-foot Seam, and the Mynyddislwyn Vein of the Radstockian. Two species are known from the Forest of Dean, extending the range of the genus to the north-east, and one species has been recorded from the Barfreston boring in the Kent Coalfield, which provides evidence of unity with the two species that Prof. Pruvost has recognized from the Insect-Bed of Liévin in the Pas-de-Calais. Thus it may be said that the three typical Hemimylacridian genera found in the South Wales coalfield are present also in the coalfields of Lens and Liévin.

Prof. Pruvost, in his 'Distribution des Faunes Insectes Paléozoiques' p. 318, indicates that the upper beds of the British Staffordian are equivalents of beds of Faisceau d'Ernestine age in the Assise de Bruay.

It seems evident from the distribution of the Welsh insect-wings that this generalization holds good in the Welsh area, for, correlated by the insect-fauna alone, the whole of the Radstockian of South Wales, and a portion of the Upper Staffordian down to the Swansea 2-foot Seam, should be regarded as the equivalent of the Assise de Bruay.

These conclusions also tend to confirm the view of Dr. A. E. Trueman, who, after an exhaustive study of the molluscan zones of the South Wales coalfield and those of the Faisceaux of the Pas-de-Calais Coal Measures, expressed the opinion that the two areas were so similar as to provide a basis for correlation.

Prof. A. H. Cox's suggested correlation of the Coal Measures of South Wales with those of Staffordshire upon lithological grounds seems likely to be supported by the insect-fauna, for, outside the Welsh area, the genera *Archimylacris* and *Aphthoroblattina* are known only from the Shropshire and Staffordshire coalfields.

November 20th, 1929.—Prof. J. W. Gregory, LL.D., D.Sc., F.R.S., President, in the Chair.

The following communication was read:—

'The Geology of the Country between Nant Peris and Nant Ffrancon (Snowdonia).' By David Williams, Ph.D., M.Sc., B.Eng., D.I.C., F.G.S.

The area described lies immediately north of Snowdon, between the Passes of Llanberis and Nant Ffrancon. The general stratigraphical succession is as follows:—

				Thickness in feet.
TERTIARY.		Olivine-Dolerite Dykes.		
LOWER CARADOC to MIDDLE LLANDEILO.	Snowdon Volcanic Suite.	Bedded Pyroclastic Series.	Pumice-tuffs...	Upper limit not seen.
			Andesitic basalt	200
			Banded pumice-tuffs	500
		Lower Rhyolitic Series.	Flinty rhyolite-tuffs	250
			Slates, with tuff-bands	250
			Vitric tuffs, with thin flows	500
			Grits and slates, with tuff-bands	200
			Nodular rhyolites	Up to 50
			Massive and banded rhyolites	200
LOWER LLANDEILO and LLANVIRN.			Gwastadnant Grits, with rhyolites and keratophyre	750
			Talgau lavas (soda-rhyolite and keratophyre)	300
			Dark slates (from about the *Nemagraptus-gracilis* Zone to below the *Didymograptus-murchisoni* Zone)	2000+

		Thickness in feet.
TERTIARY.	Olivine-Dolerite Dykes.	
	------ Arenig Beds unexposed. ------	
CAMBRIAN—		
UPPER.	Ffestiniog Grits	1000
	Maentwrog Slates	1000
	Bronllwyd Grits	Up to 1500
MIDDLE.	Green Slates at the top of the Cambrian 'Slate-Belt'	100
EARLY INTRUSIVES.	Bwlch-y-Cywion 'granite' and Moel Perfedd Granophyre (? Llandeilo age).	
	Dolerite-sills and dykes of pre-cleavage age (? Upper Llandeilo or Caradoc).	

The topmost Cambrian beds, the Ffestiniog or *Lingula* Grits, are of shallow-water origin. Near their base they have yielded *Olenus micrurus*, whereas their topmost 150 feet carry abundant *Lingulella davisii*, and may be equivalent to the *Lingulella* Band of the Portmadoc country. They are faulted against blue-black slates, probably of Lower Llanvirn age. The lowermost graptolites thus far recovered from these slates are referable to the lower part of the zone of *Didymograptus murchisoni*. Upwards, the slates pass into the paler Llandeilo slates with *Glyptograptus teretiusculus*, at the top of which occur the Talgau lavas apparently belonging to the Glyder Fach–Capel Curig volcanic suite. By contrast with the overlying Snowdonian lavas, from which they are separated by the Gwastadnant Grits, these earliest flows are notably sodic.

The Snowdon Volcanic Suite is essentially composed of potash-rhyolites and rhyolite-tuffs, succeeded, near the Devil's Kitchen, by pumice-tuffs and flows of andesitic or basaltic character. The Upper Rhyolitic Series of Snowdon itself is here absent.

Two large acid plutonic masses, Moel Perfedd and Bwlch-y-Cywion, are believed to represent the denuded plugs of the vents from which the Lower Rhyolitic Series was extruded. Differentiation within the Bwlch-y-Cywion 'granite' is discussed, and some results of contact-metamorphism are described.

A number of pre-cleavage sills and dykes of augite-dolerite and spilitic dolerite are intruded among the Llandeilo beds, and some highly decomposed quartz-dolerites are injected into the Llanvirn Slates.

Both the folding and the cleavage, which strike approximately north-east and south-west, are attributed to Caledonian earth-movements, the cleavage following closely upon the folding, but preceding the faulting. 'Cleavage-fans' are conspicuous, two 'synclines' being separated by an 'anticline'. There appears to be no evidence in this area of the post-cleavage thrusting observable on Snowdon.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[TENTH SERIES.]

No. 26. FEBRUARY 1930.

XIII.—*Descriptions of the Type-specimens of some Carboniferous Corals of the Genera* "Diphyphyllum," "Stylastræa," Aulophyllum, *and* Chætetes. By STANLEY SMITH, M.A., D.Sc., F.G.S., and W. D. LANG, M.A., Sc.D., F.R.S., F.G.S.

[Plates VII. & VIII.]

CONTENTS.

INTRODUCTION.

Fleming's material is in the Royal Scottish Museum, Edinburgh, and the corals were kindly lent to us by

Dr. J. Ritchie. Most of these were of historical interest only, adding nothing to our knowledge of the species founded by Fleming in his 'History of British Animals'; yet they include the four holotypes, which are here described.

Whilst revising Fleming's types, we have taken the opportunity to describe also certain others, namely, those of the species *Diphyphyllum lateseptatum* and *D. gracile*, which belong to the same genus as Fleming's *Caryophyllea fasciculata*; *Stylastræa inconferta* and *S. basaltiformis*, which bear the same relation to the cerioid *Lithostrotion* as *Diphyphyllum* does to the phaceloid forms of that genus; and *Chætetes radians*, which is conspecific with Fleming's *Favosites septosus*. We also discuss all the genera involved.

We thank Dr. J. Ritchie for the use of the Fleming specimens, and Prof. J. E. Marr for permitting one of us (S. S.) to cut M'Coy's types, which are in the Sedgwick Museum, Cambridge. Such of Lonsdale's specimens as are mentioned are in the British Museum, if not lost.

Lithostrotion, Fleming, 1828, p. 508.

Genotype: *L. striatum*, Fleming, 1828, p. 508 = *Lithostrotion sive Basaltes minimus striatus et stellatus*, Edward Lhwyd, 1699, p. 124, pl. [xvi.]*; 1760, p. 125, pl. xxiii.

Diagnosis.—Phaceloid and cerioid Rugose Corals, which have, typically, a columella, long major septa, and large tent-shaped tabulæ, usually supplemented at the theca by smaller and nearly horizontal tabulæ. Dissepiments are well developed in the larger species, but absent in the very small forms. Gemmation is non-parricidal. Diphymorphs of *Lithostrotion* have no columella, short septa, flat or distally arched tabulæ, and, in the phaceloid forms, parricidal gemmation.

Lithostrotion = *Stylastræa*, Lonsdale, 1845, p. 619.

Non *Stylastræa*, de Fromentel, 1861, p. 223.
Genotype of *Stylastræa*: *Lithostrotion sive Basaltes minimus striatus et stellatus*, Lhwyd, 1699, p. 124. This is the genotype of *Lithostrotion*, see Smith, 1916, p. 220, therefore *Stylastræa* is an absolute synonym of *Lithostrotion*.

Lonsdale expressly founded *Stylastræa* upon Lhwyd's Coral, but under two misapprehensions: first, that *Lithostrotion etc.*, Lhwyd, had no persistent columella; and, secondly, that *Lithostrotion striatum*, Fleming, was generically

* See S. Smith, 1916, p. 220. The matter of the genotype of *Lithostrotion* is at present before the International Committee of Zoological Nomenclature, and we intend to discuss it further in a later paper.

identical with Fleming's *L. floriforme* (Martin's "*Erismatolithus Madreporites* (*floriformis*)"). Even if Lhwyd's coral has some ambiguous features, it certainly has a columella, and Fleming explicitly founded his *Lithostrotion striatum* upon it. What we do not completely know are certain structural details and the exact size of the corallites. *Madrepora vorticalis*, Parkinson (1808, p. 45, pl. v. figs. 3 & 6) and *Astrea basaltiformis*, Conybeare & Phillips (1822, p. 359), were also founded upon Lhwyd's description and figure. Martin's coral is quite different and is well known.

It is interesting to note that non-columellate (diphymorph) corallites are much rarer among cerioid colonies of *Lithostrotion* than they are among the phaceloid forms. Both Lonsdale and M'Coy, however, have described examples of cerioid non-columellate *Lithostrotion* as *Stylastræa conferta* and *S. basaltiforme*, respectively. These differ from the phaceloid non-columellate *Diphyphyllum* in their marginal, non-parricidal gemmation; in their tabulæ, which are not differentiated into a distinct inner and outer series; and in their coarser dissepiments. We have seen that *Stylastræa* is an absolute synonym of *Lithostrotion*; and, therefore, propose the name {*Diphystrotion*} for these diphymorphs of cerioid *Lithostrotion*. It will be noted that {*Diphyphyllum*} and {*Diphystrotion*}, though differing from *Lithostrotion* in what might reasonably be supposed to be generic characters, yet do not constitute true genera, but are expressions of a trend which some external or internal stimulus has provoked to rapid development in a colony, or in certain individuals of a colony, so that the individual anticipates an evolution which is familiar in other stocks, both nearly and distantly related, and is there seen to be a phyletic, and not an individual, trend—a trend which results in new generic forms. We propose to call these forms which anticipate, but do not constitute, new genera—*genomorphs*; and to indicate them by genomorphic names, which are to be recognized as such by being placed in braces.

Moreover, in order to avoid confusion, the diphymorph trivial name might also be retained after the genomorphic name. Thus, "*Lithostrotion* sp. {*Diphyphyllum lateseptatum*} probably = *Lithostrotion* {*Diphyphyllum*} *martini*" would mean that what was formerly considered to be the species *Diphyphyllum lateseptatum* is but a diphymorph form of *Lithostrotion*, probably of *L. martini*. By this means a new concept has been expressed by adding genomorphic names to Linnæan nomenclature.

Lithostrotion, Fleming, 1828, p. 508, genomorph {*Diphyphyllum*, Lonsdale}.

Genomorphotype: *Diphyphyllum concinnum*, Lonsdale, 1845, p. 624, pl. A. fig. 4 (the genotype of the original genus *Diphyphyllum*). The type of *D. concinnum* is lost; we therefore base *Diphyphyllum* on *D. lateseptatum*, which, if not conspecific, is certainly congeneric with *D. concinnum*.

Diagnosis.—Phaceloid *Lithostrotion*, which have no columella, or one which is reduced to spines on successive tabulæ. The axial tabulæ may be flat or convex, but have down-turned edges, which either meet the tabulæ below them or extend to the dissepimental wall; the outer smaller tabulæ abut against the inner tabulæ. The dissepiments, which are small, are well developed in the larger forms. Gemmation is parricidal.

Remarks.—*Diphyphyllum* is generally used not only for phaceloid forms of *Lithostrotion*, but for any phaceloid coral with short septa. Such corals in some instances have followed the same trend as the "diphymorphs" of *Lithostrotion*—a trend almost universal in Rugose lineages, in which the septa retreat from the axis; in other instances their short septa may constitute a primitive character. We would restrict the genomorphic name {*Diphyphyllum*} to the diphymorphs of *Lithostrotion*, considering, as we have already suggested, that in this group the diphymorph structure is a condition due to other causes than normal phyletic development; and that a suitable stimulus may start any individual along this trend. Diphymorph variants accompany columellate *Lithostrotion* throughout the known range of the genus; but they first appear at a horizon slightly lower than that at which the lowest columellate *Lithostrotion* has yet been found. In these early diphymorphs the axial tabulæ are almost horizontal and inosculate with the small outer tabulæ (*Diphyphyllum* α of S. Smith *). It is probable, therefore, that they represent a primitive stage of *Lithostrotion*, while the characteristically later diphymorphs (*Diphyphyllum* β of S. Smith *) with strongly arched inner tabulæ show a reversionary trend. This point, however, needs to be established by further investigation.

Lithostrotion sp. {*Diphyphyllum concinnum* (Lonsdale)}.

Diphyphyllum concinnum, Lonsdale, 1845, p. 624.

Carboniferous Limestone. Hill of Tchirief, Kamensk, on the River Issetz, eastern side of the Ural Chain.

* 1928, p. 114.

The syntypes of {*Diphyphyllum concinnum*} cannot be traced, but they consisted, according to Lonsdale (*loc. cit.*), of "one subdivided stem (figs. 4 *a*, 4 *b*) and several portions of others (fig. 4); the larger having a nearly uniform diameter of four and a half lines [9 mm.], and the smaller of three and a half lines." Lonsdale's description and figures clearly indicate a form which closely approaches M'Coy's {*Diphyphyllum lateseptatum*}, both in details of structure (*q. v.*) and in size, but slightly larger, and with the dissepimental area relatively wider. From Lonsdale's statement it would appear that the axial tabulæ in {*D. concinnum*} occupied only half the diameter of the corallite, whereas in {*D. lateseptatum*} they occupy two-thirds. There are over 30 major septa. Since the type-specimens are no longer available, Lonsdale's description may be quoted here in full: "Stems cylindrical, nearly smooth; crossed externally by close, fine, waved lines, and stronger, unequal, distant bands; lamellæ numerous, variable; inner surface of plates furrowed strongly upwards and outwards; central area, diaphragms flat, convex or irregular; intermediate area, principal lamellæ exceeding 30, more or less waved, intermediate very unequal; interstitial prolongations of diaphragms inclined sharply downwards, accessory plates nearly horizontal; outer area, lamellæ variable in strength and range, interstitial plates largely vesicular; terminal cup deep, lined by edges of the lamellæ, no central boss."

The statement in the original description that the inner surface of the plates (septa) are furrowed rather suggests that the undulations which characterise the sides of the septa of the holotype of *Stylastræa inconferta* are also present in this coral. Until topotype material is available, this form cannot be certainly identified nor the name authoritatively used.

Lithostrotion sp. {*Diphyphyllum lateseptatum* (M'Coy)}.
(Pl. VII. figs. 1–4.)

Diphyphyllum lateseptatum, M'Coy, 1849, p. 8; 1851, p. 88, pl. iii. *c.* figs. 10, 10 *a*, *b*.

Holotype.—Sedgwick Museum, Cambridge. Specimen No. 123, Carboniferous Limestone, Corwen.

The specimen is a piece of dark-coloured limestone, 4·5 cm. × 3·5 cm. × 0·3 cm. It has been broken, but the pieces fit together. It enclosed fourteen fairly straight, more or less complete, corallites, which stand out from its upper weathered surface, and are well exposed as longitudinal sections on one of its sides. The type-material also includes

an isolated and broken corallite, figured by M'Coy (fig. 10 *a*), and without doubt detached from the same specimen. M'Coy's remark that the corallites were upwards of 8 inches in length presupposes either that the holotype was originally longer or that he had other specimens as well.

The largest corallite is 8 mm. in diameter, with thirty-four major septa 2 mm. to 2·5 mm. long; and the smallest corallite is only 4 mm. in diameter. The minor septa are one-third the length of the major, *i.e.*, less than 1 mm.

In transverse sections of this and in most other sections of {*Diphyphyllum*} the major septa appear to end against a complete ring, which suggests an aulos, or an inner wall, but this is merely formed by the intersections of axial tabulæ. The character of the tabulæ is well seen in the longitudinal sections of the topotypes (Pl. VII. figs. 3 *b*, 4 *b*). They include two series of plates, of which the inner series are horizontally disposed, convex, and superposed one upon another, forming an axial column: they are unequally spaced, some being very close together, others 1·5 mm. apart. The outer tabulæ, which slope downwards and towards the periphery, occupy a very narrow area, and abut, on the one hand, against the down-bent margins of the inner tabulæ and, on the other, against the innermost dissepiments. Here and there, however, the wall of the axial column is broken by an inner tabula extending to the theca, instead of curving round to touch the tabula below. The dissepiments are small and strongly arched, but vary in size. There are usually two rows, seldom only one, sometimes three. In a corallite 6 mm. in diameter the axial tabulæ occupy 4 mm., and the outer tabulæ and dissepiments together 1 mm. on each side.

It is to be noted that an impersistent columella is often represented by spines on successive tabulæ, and that some specimens (*e.g.*, British Museum R. 4506) have the rudiments of an axial complex like that described in *Nemistium edmondsi* (Smith, 1928, pp. 116–7, pl. v. figs. 1–4), into which form "species" of {*Diphyphyllum*} imperceptibly merge.

Lithostrotion sp. {*Diphyphyllum gracile* (M'Coy)}.
(Pl. VII. figs. 5 & 6.)

Diphyphyllum gracile, M'Coy, 1851², p. 168; 1851, p. 88, text-figs. *d*, *e*, and *f* on p. 88.

Holotype.—Sedgwick Museum, Cambridge. Specimen 122 (Carboniferous). The Impure Limestone of Lowick, Northumberland.

This consists of part of a corallum, embedded in a piece of dark-coloured limestone 10 cm. × 7 cm. × 5 cm., from which a small piece has now been cut in order to provide the thin sections here figured.

The slender cylindrical corallites are erect and closely packed. Their diameter is usually rather more than 3 mm., but one or two—much bigger than the rest—are as much as 6 mm. There are about 20 major septa between 0·5 mm. and 1 mm. long. The minor septa are very short indeed, usually being less than one-fourth the length of the major, and thus hardly noticeable in many of the corallites. The axial tabulæ, which may be as much as 1 mm. apart and are fairly evenly spaced, are arranged as in the other forms of {*Diphyphyllum*}. They thus appear strongly arched, although their crest may be flat. They occupy an area 2 mm. in diameter, *i. e.*, two-thirds of the corallite; whilst the narrow peripheral area about 0·5 mm. wide is occupied mainly by the outer tabulæ, which are nearly horizontal but slope slightly downwards towards the periphery. Some dissepiments may be present, but these at most form merely a single row and are not persistent. A columella is sometimes represented by a series of short spines, which rise from successive tabulæ, but do not reach the tabula above.

On the whole, M'Coy's description is very accurate, but he evidently confused the outer tabulæ with the dissepiments. We have frequently noted corals intermediate in character between M'Coy's type of {*D. gracile*} and small columellate *Lithostrotion*—*L. junceum* (Fleming) as well as small forms of *L. irregulare* (Phillips).

Lithostrotion sp. {*Diphyphyllum fasciculatum* (Fleming)}.
(Pl. VII. figs. 7 & 8.)

Caryophyllea fasciculata, Fleming, 1828, p. 509.
Non *Caryophyllia fasciculata*, Lamarck, 1816, p. 226 (Recent).
Non *Lithodendron fasciculatum*, Phillips, 1836, p. 202, pl. ii. figs. 16 & 17.
Non *Caryophyllia fasciculata*, de Koninck, 1842, p. 17, pl. D. figs. 5 *a–c*, pl. G. figs. 9 *a*, *b*.
Non *Lithodendron fasciculatum*, Keyserling, 1846, p. 170, pl. iii. figs. 2, 2 *a–b*.
Non *Diphyphyllum fasciculatum*, D'Orbigny, 1850, p. 159.
? *Lithodendron fasciculatum*, Portlock, 1843, p. 335.

Original description.—"Crowded, branched, round, nearly cylindrical, slightly flexuous, and about a quarter of an inch in diameter.—Madreporite, *Park.* Org. Rem. 51, t. vi. f. 8. —Madrepora cespitosa, *Mart.* Derb. t. 17, *Carboniferous Limestone.*"

Syntypes.—There are two specimens in the Fleming collection labelled "*Caryophyllea fasciculata*," namely 1870.14.374 and 1870.14.337. The first of these (1870.14.374) is here chosen as the lectotype. This is from Skate Craig, Dunbar.

Lectotype.—The specimen measures 18 cm. × 10 cm. × 5 cm.; the coral and matrix are light-coloured. The corallites, which have an average diameter about 5 mm., are crowded and rather flexuous. The structure is the same as that of the other three forms of *Diphyphyllum* here described. There are about twenty-four major septa about 1·5 mm. long; the minor septa attain only half, or less than half, this length. The axial tabulæ are approximately 3 mm. in diameter, and are generally nearly 1 mm. apart, but the intervals between them vary, sometimes being somewhat more than 1 mm. and sometimes much less. The outer tabulæ and the dissepiments together occupy 1 mm. on each side of the axial tabulæ. The dissepiments usually fill a narrower area than the outer tabulæ, and are typically arranged in one row only, but here and there there are two rows. The dissepimental vesicles contain much stereome.

It is possible that Fleming knew of Lamarck's *Caryophyllia fasciculata* when he named this coral, but we cannot assume this, for he makes no reference to Lamarck; and since his species belongs to an entirely different genus and class, Fleming's name may be used for those forms of {*Diphyphyllum*} that are intermediate in size between {*D. latesep-tatum*} and {*D. gracile*}, and otherwise agree with his type of *Caryophyllum fasciculata*. The species should, therefore, be designated as *Lithostrotion* sp. {*Diphyphyllum fasciculatum* (Fleming)}.

Lithostrotion, Fleming, 1828, p. 508, genomorph {*Diphystrotion*, nov.}.

Genomorphotype: *Stylastræa inconferta*, Lonsdale, 1845, p. 621 pl. A. figs. 2, 2 *a–c*.

Diagnosis.—Cerioid *Lithostrotion* in which there is no columella, or one which is reduced to spines on successive tabulæ, and in which the tabulæ are slightly convex or flat and in most cases complete. The dissepimental tissue is typically coarse. Parricidal gemmation has not been observed.

Remarks.—{*Diphystrotion*} leads on to *Thysanophyllum*, Thomson (strictly interpreted by the genotype), which has a thoroughly lonsdaleoid border; but not to "*Thysanophyllum*" *vermiculare*, which is the corresponding development of the fasciculate {*Diphyphyllum*}.

Lithostrotion sp. {*Diphystrotion inconfertum* (Lonsdale)}. (Pl. VII. figs. 9–13.)

Stylastræa inconferta, Lonsdale, 1845, p. 621, pl. A. figs. 2, 2 *a–c*.

Holotype.—British Museum, specimen R. 17562, Kossatchi-Datchi, South of Miask, eastern side of Ural Chain (about 900 miles due E. of Moscow). There are isolated corallites and sections of parts of the same specimen separately numbered.

The specimen, which is 10 cm. long and 5·5 cm. × 4 cm. transversely, consists of a few easily separable prismatic corallites, the largest of which is about 10 mm. in diameter. Most of them are to some extent crushed and broken. The material is re-crystallized (and to some extent dolomitized); and the vesicular tissue is not completely filled by mineral calcite, although it contains much stereome. The epitheca is finely striated longitudinally and wrinkled transversely. This, and the general shape, is very well shown in Lonsdale's figure (pl. A. fig. 2).

In most of the corallites there are eighteen major septa, generally including one septum much longer than the rest, like that of *Thysanophyllum orientale*, Thomson. This counter-septum reaches beyond the axis, whilst the others only extend inwards 2 to 4 mm. The minor septa are very feebly developed, few being as much as 1 mm. In most cases the septa reach the epitheca, but here and there—on one side or another of a particular corallite—they end peripherally against a large dissepiment. The septa are thin and, seen in transverse section, rather crooked, particularly the long counter-septum. The sides of the septa, where exposed by longitudinal fracture *, are corrugated by sinuous folds, which slope downwards axially and are themselves transversed at right angles by very fine and rather faint corrugations.

There is no continuous columella, but some axial structures recalling those in *Nemistium edmondsi* † may occur on successive tabulæ.

The tabulæ, which may or may not be complete, are convex distally, reach the theca, and are not differentiated into distinct series, as in the forms of {*Diphyphyllum*} which we have described. They are unequally distributed, and may be as much as 2 mm. apart, although the average distance between them is less than 1 mm.

* This particular specimen breaks longitudinally in an unusual manner; namely, along the sides of the septa (which are thus exposed to view), owing to some incoherence between the septa and the matrix which fills the vesicular tissue between them.

† Smith, 1928, pp. 112–120.

The dissepiments are large, and form only a single, or at most a double, row of strongly-arched plates. The width of the dissepimental area is about the radius of the corallite.

Lithostrotion sp. {*Diphystrotion kendalense,* new form}.
(Pl. VII. figs. 14 & 15.)

"*Stylastræa basaltiformis* (Phill. sp.)," M'Coy, 1851, p. 107, no figure.

Holotype.—Sedgwick Museum, Cambridge. Specimen 130. Specimens 131 and 133 parts of the same piece of coral. Carboniferous Limestone, Kendal.

The holotype is a little over 25 cm. in length, and consists of unusually long, remarkably straight, easily separable corallites, some of which run the entire length of the specimen, and most of them nearly as far. The material is well preserved, but appears to be a little dolomitized, and here and there the interstices of the coral are free from mineral matter. As in *S. inconferta*, the corallites are lightly striated and transversely wrinkled, and attain a maximum diameter of about 10 cm., but have about twenty-five major septa, which are not more than 3 to 4 mm. long. The septa reach the epitheca, but the major septa are very often interrupted by the large dissepiments, and appear discontinuous in transverse section. For the most part the axial region is quite free of longitudinal tissue. The tabulæ, which are nearly all complete, are flat or sagging, but bend downwards near their periphery. The dissepiments vary considerably in size, some being distinctly large and others quite small. The dissepimental area occupies about half the radius of the corallite.

{*D. kendalense*} closely resembles {*D. inconfertum*}, but shows some small differences, as may be seen from the description and in the figures. The flatter tabulæ, almost entire absence of any axial structure, and greater development of dissepimental tissue are the chief. The septa, moreover, do not show the corrugations mentioned in Lonsdale's form.

"*Stylastræa basaltiformis* (Phill. sp.)," M'Coy, as we have seen, is a diphymorph, and is not *Astrea basaltiformis*, Conybeare & W. Phillips, which was founded on Lhwyd's figure already quoted (p. 178). It is therefore necessary to re-name M'Coy's form, and, since we consider {*Diphystrotion*} to be a genomorph of *Lithostrotion*, we name it *Lithostrotion* sp. {*Diphystrotion kendalense*}.

It is not possible to tell from John Phillip's figure or his description of "*Cyathophyllum basaltiforme*" whether the form is, or is not, identical with M'Coy's.

AULOPHYLLUM, Edwards & Haime, 1850, p. lxx.

Genotype: *Clisiophyllum prolapsum*, M'Coy, 1849, p. 3; 1851, p. 95, pl. 3 *c*. figs. 5, 5 *a*. Carboniferous Limestone, Derbyshire. = *Turbinolia fungites*, Fleming, 1828, p. 510. = *Fungites*, Ure, 1793, p. 327, pl. xx. fig. 6.

Diagnosis.—Simple, trochoid Rugose corals, often of large size, with a compact well-defined central column, which, seen in transverse section, has a cuspidate outline and is built up of closely-packed vertical and horizontal elements. The major septa do not usually extend quite to the axial complex. The tabulæ are small and arched, and slope down towards the periphery. There is a well-developed peripheral zone of numerous small dissepiments.

Remarks.—*Aulophyllum* differs from all other Clisiophyllids in having the number of radial lamellæ within the central column greater than the number of septa, and from most in having no axial plates. In other respects it agrees with the typical Clisiophyllids.

Aulophyllum fungites (Fleming).

Turbinolia Fungites, J. Fleming, 1828, p. 510.
Aulophyllum fungites (Fleming), Edwards & Haime, 1851, p. 413; 1852, p. 188.

Fleming describes the species, which is the genotype of *Aulophyllum*, as: "Inversely conical, lengthened; more or less bent; longitudinally striated, with irregular transverse wrinkles; star concave, with a large central axis. Fungites, *Ure*, Ruth. 327, lxx. fig. 6.—In *Carboniferous Limestone*, common; frequently termed *Rams' horns*." Eight syntypes (Specimens 1870.14.428) remain in Fleming's collection, most of them being typical material and conspecific with D. Ure's specimen of *Fungites* (1793, p. 327, p. xx, fig. 6), to which Fleming refers, and which has been virtually chosen as the lectotype; although in the detailed description and summary of the literature of *Aulophyllum fungites* by S. Smith (1913, pp. 51–77, pls. v.–ix.), and in Gregory's later remarks (1917, pp. 223–4), this was not definitely stated. In order to avoid any future ambiguity, we hereby choose Ure's figured specimen of *Fungites* as the lectotype of *Turbinolia fungites*, Fleming.

It may be added that Thomson (1882, p. 481) referred Ure's specimen of *Fungites* (of which he cut sections) to *Cyclophyllum*, Duncan & Thomson, 1867, and figured it as *C. fungites*. But it has been shown conclusively that *Cyclophyllum*, Duncan & Thomson, is identical with *Aulophyllum*

(see S. Smith, 1913, pp. 54–55, and Gregory, 1917, pp. 223–4). It may also be pointed out that in 1867 Duncan and Thomson founded *Cyclophyllum* on two syntypes, namely, *Aulophyllum fungites* (*Turbinolia fungites*, Fleming) and *A. bowerbanki*, Edwards & Haime, of which the former was regarded by Edwards and Haime as conspecific with the genotype of *Aulophyllum*; and we consider that the two forms are identical.

Gregory (1917, p. 273) chose *A. bowerbanki*, Edwards & Haime, as genolectotype of *Aulophyllum*, but Edwards and Haime (1850, p. lxx) had already given *Clisiophyllum prolapsum* as the genoholotype.

CHÆTETES, G. Fischer von Waldheim, 1830, sig. *d*, 4; 1837 (second edition), p. 160.

Genosyntypes: *Chætetes radians*, G. Fischer v. Waldheim, 1830, sig. *d*, 4.
Chætetes dilatata, " " " "
Chætetes cylindrica, " " " "
Chætetes incrustans, " " " sig. *e*, 1.
Chætetes gigantea, " " " "
Chætetes jubata, " " " "

Genolectotype: *Chætetes radians*, G. Fischer von Waldheim, 1830, sig. *d*, 4: 1837, p. 160, pl. xxxvi. fig. 3 (referred to in text as fig. 6), Carboniferous. Miatchkova (14 miles S.W. of Moscou), Russia. See H. M. Edwards and J. Haime, 1850, p. lxi.

Diagnosis.—Cerioid or meandroid Tabulate corals, which form tumular or stratiform masses, and have small corallites with thin, complete, horizontal tabulæ, but no septa, and probably no mural pores. The walls separating the individual [illegible] are often incompletely formed, and may appear [illegible] may be [illegible], and [illegible]

[illegible] Waldheim's descriptions of the genosyntypes of *Chætetes* are in themselves too inaccurate for diagnostic purposes, nevertheless the figures clearly and unmistakably show that the corals belong to the same genus, and probably all to the same species, as the coral [illegible] figured by Lonsdale, 1845, p. 595, pl. A. figs. 9, [illegible] *radians*, from Borovitchi etc., Government [illegible] Lonsdale's figured specimen is in the British [illegible] *Chætetes radians* is interpreted by [illegible] conspecific with *Favosites septosus*, Fleming. [illegible] in Lonsdale's specimen the tabulæ are grouped [illegible] wide apart and near together, [illegible] Fleming's [illegible] are fairly equally distributed, [illegible] observed both conditions in British and Russian

specimens, and consider the distribution of tabulæ to be due to environmental conditions, and not to be a congenital character. The walls are thicker in Lonsdale's specimen than in Fleming's, and in consequence of this the corallites of Lonsdale's specimen have a much more rounded interior.

Fischer von Waldheim's statement that the tubes were without diaphragms can be explained, either by the fact that the tabulæ had been destroyed by silification, which, he says, affected many of his specimens, or that he did not notice the thin and distant tabulæ on its broken surface.

Both Edwards and Haime (1851, pp. 259–263; 1852, pp. 157–8) and Thomson (1882, p. 201) regarded *Chætetes radians*, Fischer von Waldheim, and *Favosites septosus*, Fleming, as distinct species, and even as distinct genera, on the grounds that the latter had, and the former had not, mural pores. Nicholson and Etheridge (1877, pp. 366–367), on the other hand, could detect pores in neither species, and considered the two forms to be at least congeneric. As to the mural pores, we have not been able to detect them ourselves, but Thomson claims to have done so in specimens from Scotland (1882, p. 197). If present, they are necessarily very small, and would easily be obliterated in the process of mineralization; whereas those of the genotype of *Alveolites* are large.

Two clear trends are manifest in *Chætetes*, namely, a thickening of the wall and the development of such meandroid colonies as are exhibited in an exaggerated degree by the form from Ireland recently described and figured by Smyth (1925, pp. 319–320, pls. xiv., xv.).

Chætetes radians, Fischer von Waldheim, *interp.* Lonsdale.

Chætetes radians, Fischer von Waldheim; Lonsdale, 1845, p. 595, pl. A. figs. 9, 9 *a*. This is probably *Chætetes radians*, Fischer von Waldheim, 1837, p. 160, pl. xxxvi. fig. 3 (*non* fig. 6 as in text): it is certainly *Favosites septosus*, Fleming.

Lonsdale's material.—Specimens from Kaluga (Government of Kaluga, 100 miles S.S.E. of Moscow); Borovitchi (Government of Novgorod, 240 miles N.E. of Moscow) and Vitegra, on S.W. side of Lake Onega (Government of Olonetz, nearly 400 miles N. by E. of Moscow).

Neotype.—On the assumption that Fischer von Waldheim's material is lost, we select Lonsdale's figured specimen, British Museum 26356, Carboniferous, Kaluga or Vitegra (old label reads Kaluga and Vitegra), as neotype.

The specimen, 10 cm. high, 6·5 cm. wide, is part of a large tumular colony of radiating, separable, prismatic corallites.

The corallites are fairly regular in section, and are almost 0·5 mm. in diameter. They have thick walls, rounded angles, and very thin tabulæ, which may be as much as 5 or 6 mm. distant or may be very close together. The tabulæ occur at the same level in neighbouring corallites, and form continuous platforms. Wide bands of widely-separated tabular platforms alternate regularly with narrow bands of closely-packed platforms, as shown by Lonsdale's fig. 9. It should be added, however, that the widely-separated tabulæ of one part of the corallum may approximate in another part of the mass if the individual bands are followed far enough. The neotype also exhibits very clearly the incomplete walls mentioned in our diagnosis and well illustrated by Lonsdale in fig. 9 *a*.

Chætetes septosus (Fleming). (Pl. VIII. fig. 1.)

Favosites septosus, Fleming, 1828, p. 529.
Alveolites septosa, Edwards & Haime, 1851, p. 259; 1852, p. 157, et auctt.

Holotype.—Specimen 1870.14.123, Fleming Collection, Royal Scottish Museum, Edinburgh. Carboniferous Limestone. No locality.

The black holotype exactly answers Fleming's description: "Hemispherical, nearly 2 inches in diameter, the tubes radiating from the centre irregularly, divided internally by simple transverse plates.—*Carboniferous Limestone.*" It is a small colony, 7 cm. in diameter and 4 cm. high. The base is a broken surface. The corallum has been cut longitudinally, and the face of each half roughly polished.

The corallites radiate from a centre, and the colony has the appearance, characteristic of *Chætetes*, of having been built up of several concentric layers. The corallites are prismatic and fairly uniform in size, averaging 0·75 mm. in diameter. The tabulæ are complete, horizontal, and fairly equally distributed at intervals of about 0·5 mm. An incomplete wall is present in many of the corallites, and a slight tendency to assume the meandrine condition is seen locally.

Edwards and Haime's description (1852, p. 157), based on material from various localities, thus agrees very closely with the type.

J. Thomson's remarks upon "*Alveolites septosa*" (1882, p. 205; 1883, p. 344) more fully describe the form, and are perhaps even more accurate in detail, but we disagree with his statements that the corallites are from 5 to 11 lines long, since they may attain a length of several centimetres if not

interrupted by the superposition of new growth upon old, which is frequent and referred to by Edwards and Haime (1852, p. 157).

Chætetes depressus (Fleming).
(Pl. VIII. fig. 2.)

Favosites depressus, Fleming, 1828, p. 529.
Alveolites depressa, Edwards & Haime, 1851, p. 260; 1852, p. 158, et auctt.

Holotype.—Specimen 1870.14.122, Fleming Collection, Royal Scottish Museum, Edinburgh. Carboniferous Limestone. No locality.

The original description reads:—"An extended plate about an inch in height, tubes vertical, rather smaller than the preceding, and less divided.—*Carboniferous Limestone*," and this agrees so closely with specimen 1870.14.122 that there can be little doubt that it is that which Fleming had in mind when he wrote these words. It is a flat piece of black limestone, 8 cm. × 2·5 cm., enclosing a thin band of coral 2·5 cm. in thickness. The small parallel corallites are very well exposed on the weathered surface, where the coral stands out white (although crossed by numerous thin black lines) from the dark matrix, and the separable character of the "tubes" is clearly demonstrated.

The corallites are sub-prismatic, nearly cylindrical, and average less than 0·2 mm. in diameter. As far as one is able to judge, the tabulæ are unevenly distributed, in some places lying close together, but in others far apart.

Chætetes depressus is easily distinguished from *Ch. septosus* by its very much smaller corallites, which are only about one-fourth the diameter of the large form. Whilst both species may form extensive stratiform growths, that habit is usual in *C. depressus*, whereas a tumiform shape is more general in *C. septosus*.

Alveolites, Lamarck, 1801, p. 375.

Genosyntypes: *Alveolites escharoides*, Lamarck, 1801, p. 376 (l'astroïte de Guettard, 1770, p. 499, pl. xlv. fig. 1).
Alveolites suborbicularis, Lamarck, 1801, p. 376 [Devonian, neighbourhood of Dusseldorf].

Genolectotype: *Alveolites spongites*, Steininger, 1831; 1834, p. 334, pl. xx. figs. 4, 4 *a–c*. = *Calamopora spongites*, var. *tuberosa*, Goldfuss, 1826, p. 80, pl. xxviii. figs. 1 *a*–1 *e*. See Edwards & Haime, 1850, pl. lxi. = *Alveolites suborbicularis*, Lamarck.

Diagnosis.—Massive tabulate corals, which form large colonies built up of superposed layers enwrapping some nucleus. The corallites are small, very oblique, more or less

triangular in section, and have moderately thick walls, perforated by a few large mural pores. The septa may be altogether suppressed, but are typically represented by a single septum on the lower lip of the very oblique calice.

Remarks.—The characters distinguishing *Alveolites* from *Chætetes* have been thoroughly discussed by Nicholson and Etheridge, 1877, and again by Nicholson, 1879, pp. 117–125 and 260–266. The form of the calice and the solitary septa are well illustrated by Goldfuss's figure (1826, pl. xxviii. fig. 1 *c*). The young corallites arise at the angles between the older ones.

Literature.

W. D. Conybeare & W. Phillips. 1822. 'Outlines of the Geology of England and Wales.' 8vo. London.

P. M. Duncan & J. Thomson. 1867. "On *Cyclophyllum*, a new Genus of the Cyathophyllidæ, with Remarks on the Genus *Aulophyllum*." Quart. Journ. Geol. Soc. vol. xxiii. pp. 327–330, pl. xiii.

H. M. Edwards & J. Haime. 1850, 1852. 'A Monograph of the British Fossil Corals.' Pts. 1 & 3. Palæont. Soc., London.

——. 'Monographie des Polypiers Fossiles des Terrains Palæozoïques.' Arch. Mus. Hist. Nat. vol. v. pp. 1–502.

G. Fischer von Waldheim. 1830 & 1837. "Oryctographie du Gouvernement de Moscou." Folio. Moscow. (Second edition, 1837.)

J. Fleming. 1828. "A History of British Animals." 8vo. Edinburgh.

E. de Fromentel. 1861. 'Introduction à l'étude des Polypiers Fossiles.' 8vo. Paris.

G. A. Goldfuss. Petrefacta Germaniæ, &c. 1826–44. Fol. Düsseldorf.

J. W. Gregory. 1917. "Thomson's Genera of Scottish Carboniferous Corals." Trans. Geol. Soc. Glasgow, vol. xvi. part ii. for 1916–17, pp. 220–243.

Guettard. 1770. Mémoires sur différentes parties des Sciences et Arts, vol. iii. pp. 4 & 544, 7 pls. 4to. Paris.

A. von Keyserling. 1846. 'Wissenschaftliche Beobachtungen auf einer Reise in das Petschora-land.' 4to. St. Petersburg.

L. G. de Koninck. 1841–44. 'Description des Animaux Fossiles qui se trouvent dans le Terrain Carbonifère de Belgique.' 4to. Liège.

J. B. Lamarck. 1801. 'Système des Animaux sans Vertèbres.' 8vo. Paris.

——. 1816. 'Histoire Naturelle des Animaux sans Vertèbres,' vol. ii. Paris.

Edward Lhwyd. 1699. 'Lithophylacii Britannici Ichnographia,' &c. 8vo. London and Leipzig. 1760, Editio altera. Oxford.

W. Lonsdale. 1845. In R. I. Murchison and others, 'The Geology of Russia in Europe and the Ural Mountains,' vol. i. 4to. London and Paris.

F. M. M'Coy. 1849. 'On some new Genera and Species of Palæozoic Corals and Foraminifera.' Ann. & Mag. Nat. Hist. ser. 2, vol. iii. pp. 1–20.

——. 1851–4. "British Palæozoic Fossils," in A. Sedgwick, 'British Palæozoic Rocks.'

——. 1851[2]. 'Descriptions of some new Mountain Limestone Fossils.' Ann. & Mag. Nat. Hist. ser. 2, vol. vii. pp. 167–175.

W. Martin. 1809. 'Petrificata Derbensia,' &c. 4to. Wigan.

H. A. NICHOLSON. 1879. 'On the Structure and Affinities of the "Tabulate Corals" of the Palæozoic Period.' 8vo. Edinburgh and London.

H. A. NICHOLSON & R. ETHERIDGE, Jun. 1877. "Notes on the Genus *Alveolites*, Lamarck, and on some Allied Forms of Palæozoic Corals." Journ. Linnean Society (Zoology), vol. xiii. pp. 353–370, pls. xix. & xx.

A. D. D'ORBIGNY. 1850. 'Prodrome de Paléontologie Stratigraphique,' vol. i. 12mo. Paris.

J. PARKINSON. 1808. 'Organic Remains of a Former World,' vol. ii. 4to. London.

J. PHILLIPS. 1836. 'Illustrations of the Geology of Yorkshire,' vol. ii. 4to. London.

J. E. PORTLOCK. 1843. 'Report on the Geology of Londonderry, and Parts of Tyrone and Fermanagh,' &c. 8vo. Geological Survey, Ireland.

S. SMITH. 1913. "The Genus *Aulophyllum*." Quart. Journ. Geol. Soc. vol. lxix. pp. 51–77 and pls. v.–ix.

——. 1916. "The Genus *Lonsdalia* and *Dibunophyllum rogosum*," *ibid.* vol. lxxi. for 1915, pp. 218–272 and pls. xvii.–xxi.

——. 1928. "The Carboniferous Coral *Nemistium edmondsi*, gen. et sp. n." Ann. & Mag. Nat. Hist. ser. 10, vol. i. pp. 112–120, pl. v.

L. B. SMYTH. 1925. "On a Meandrine Form of *Chætetes*." Geol. Mag. vol. lxii. pp. 319–322, pls. xiv. & xv.

J. STEININGER. 1834. "Observations sur les Fossiles du Calcaire Intermédiare de l'Eifel." Mém. Soc. Géol. France, vol. i. pp. 331–371. Separately issued as a tract in 1831.

J. THOMSON. 1882. "On a new Family of Rugose Corals, including the Genera *Cyclophyllum*, *Aulophyllum*, and on the Genus *Clisiophyllum*." Proc. Phil. Soc. Glasgow, vol. xiii. pp. 471–551, pls. i.–vii.

——. 1882. "On the Genus *Alveolites*, *Amplexus*, and *Zaphrentis* from the Carboniferous System of Scotland." Proc. Phil. Soc. Glasgow, vol. xiii. pp. 194–237, pls. i–iv.

——. 1883. "On the Development and Generic Relation of the Corals of the Carboniferous System of Scotland." Proc. Phil. Soc. Glasgow, vol. xiv. pp. 296–502, pls. i.–xiv.

D. URE. 1793. 'The History of Rutherglen and East-Kilbride.' 8vo. Glasgow.

EXPLANATION OF THE PLATES.

PLATE VII.

Figs. 1 & 2. *Lithostrotion* sp. {*Diphyphyllum lateseptatum* M'Coy}. Holotype. Sedgwick Museum, Cambridge, No. 123. Lower Carboniferous, [Upper Grey Limestone ?, Hafod-y-Calch], Corwen, Merionethshire.

Fig. 1. Transverse section, × 1·5.

Fig. 2. Longitudinal section, exposed on face of specimen. Nat. size.

Figs. 3 & 4. The same. Topotypes. British Museum, Morton Collection R. 27243 and R. 27244. Lower Carboniferous, Upper Grey Limestone, Hafod-y-Calch, Corwen.

Figs. 3 *a*, 3 *b*. Transverse and longitudinal sections of R. 27243. × 2.

Figs. 4 *a*, 4 *b*. Transverse and longitudinal sections of R. 27244. × 2.

Figs. 5 & 6. *Lithostrotion* sp. {*Diphyphyllum gracile*, M'Coy}. Holotype. Sedgwick Museum, No. 122. Lower Carboniferous, "impure Limestone." Lowick, Northumberland.

Fig. 5. Longitudinal section. × 1·5.

Fig. 6. Tranverse section, × 1·5 (the detached corallite is much larger than the rest).

Figs. 7 & 8. *Lithostrotion* sp. {*Diphyphyllum fasciculatum* (Fleming)}. *Caryophyllia fasciculata*, Fleming. Lectotype. Royal Scottish Museum, Edinburgh. Lower Carboniferous. Skale Craig, Dunbar.

Fig. 7. Longitudinal section. × 2.

Fig. 8. Transverse section. × 2.

Figs. 9–13. *Lithostrotion* sp. {*Diphystrotion inconfertum* (Lonsdale)}. =*Stylastræa inconferta*, Lonsdale. Holotype. British Museum R. 17562. Lower Carboniferous. Kossatchi-Datchi, south of Miask, eastern side of the Ural Chain.

Figs. 9, 10, & 11. Transverse sections, R. 17566 (figs. 9, 10), R. 17576. × 2.

Figs. 12 & 13. Longitudinal sections, R. 17576, R. 17577. × 2.

Figs. 14 & 15. *Lithostrotion* sp. {*Diphystrotion kendalense*, new form}. = "*Stylastræa basaltiformis* (Phill.)," M'Coy. Sedgwick Museum, No. 131. Lower Carboniferous. Kendal, Westmorland.

Fig. 14. Longitudinal section. × 2.

Fig. 15. Transverse section. × 2.

PLATE VIII.

Fig. 1. *Chætetes septosus* (Fleming) = *Favosites septosus*, Fleming. Lectotype (? holotype). Royal Scottish Museum, Edinburgh, Fleming Collection, No. 1870.14.123. Lower Carboniferous (Scotland ?). × 3·5.

Fig. 2. *Chætetes depressus* (Fleming) = *Favosites depressus*, Fleming. Holotype. Royal Scottish Museum, Fleming Collection, No. 1870.14.122. Lower Carboniferous (Scotland ?). × 3·5.

XIV.—*Thysanoptera from Africa.*

By DUDLEY MOULTON, San Francisco, California.

THIS paper includes a record of various species of the Terebrantia which have been received principally from Mr. Frederick Laing of the British Museum, London, who has forwarded collections made by Mr. R. E. Turner. Collections from Messrs. A. Cuthbertson and Rupert W. Jack, Rhodesia, and Mr. A. W. J. Pomeroy, Gold Coast, are also included. Another paper will be offered shortly on

those species belonging to the Tubulifera. I wish to express my sincere appreciation to these men, who, by their co-operation, have made this paper possible.

Superfamily ÆOLOTHRIPOIDEA, Hood.

Family Orothripidæ, Bagn., 1926.

AUDIOTHRIPS, gen. nov.

Antennæ 9-segmented, ovipositor upturned and closely related to *Erythrothrips*, Moulton, except that in this new genus the maxillary palpus has five segments instead of eight, and the sense-areas on the third and fourth antennal segments are elongate, extending the full length of the segments, while in *Erythrothrips* they are much shorter and occupy a position only in the distal ends of the segments. This genus approaches *Franklinothrips*, Back, in the great length of the sense-areas and by the elongate third antennal segment, which, however, is much shorter and broader in *Audiothrips* than in *Franklinothrips*.

Genotype, *Audiothrips perplexus*, sp. n.

1. *Audiothrips perplexus*, sp. n.

Female holotype.—Colour of body and legs uniformly deep brown. Antennal segments 1, basal three-fourths of 2 and 4 to 9 concolorous with head; tip of 2 and all of 3 whitish, 4 whitish at base gradually shading to brown at tip. Wings whitish with a dark longitudinal band extending from extreme base, including scale, to tip. This brown band is somewhat narrower in basal third and wider in middle third.

Total body-length 2·5 mm.; head, length ·23 mm., width ·23 mm.; prothorax, length ·16 mm., width ·23 mm.; pterothorax, width ·35 mm.; greatest width of abdomen ·43 mm. Antennæ: length (width) i. 45 (42), ii. 51 (33), iii. 174 (27), iv. 120 (27), v. 60 (24), vi. 45 (24), vii. 48 (21); viii. 24; ix. 12; total length 600 μ.

Head subquadrate; cheeks slightly arched, without conspicuous spines. Eyes extending posteriorly on ventral side. Ocelli normal. Maxillary palpi geniculate, with five segments, although the sutures between the second and third and third and fourth are more or less indistinct. Labial palpi 4-segmented, basal joint very small. Antenna with nine segments, 2·6 times as long as head, segment 3 elongate-cylindrical, ·8 as long as head and 6·5 times as long as wide.

Segment 4 also elongate-cylindrical and ·75 as long as segment 3; 5, 6, and 7 almost subequal, 8 and 9 small, conical, and closely joined to 7. Sense-area on segment 3 narrow, slightly enlarged, and bent at distal end, extending along outer side to near extreme base; sense-area on segment 4 similarly shaped, and also extending to extreme base of segment.

Prothorax small, about as wide as head and ·7 as long, without conspicuous markings or spines. Pterothorax with sides evenly arched. Legs long and slender. Fore femora only very slightly larger than middle and hind femora. Each fore tarsus with a hook-shaped tooth. Wings fully developed, with ring-vein, two longitudinal veins, and four cross-veins.

Abdomen elongate-ovate, with prominent spines only on ninth and tenth segments.

This species resembles *Erythrothrips arizonæ*, Moulton, in shape of body and colour of wings. The third antennal segment resembles *Æolothrips nasturtii*, Jones, but is somewhat longer. It is difficult to state with certainty whether the sutures between the second and third and the third and fourth segments of maxillary palpi are complete in the holotype; they are distinct in the paratype. The sense-areas of third and fourth antennal segments extend over the entire length of the segments as in *Franklinothrips*.

Type material.—Female holotype (Moulton no. 2838) and one ♀ paratype (no. 2831), taken from an unknown host, iii. 1927 (*R. E. Turner*). Holotype deposited with British Museum, paratype in author's collection.

Type-locality.—Orange Free State, South Africa.

Family Æolothripidæ, Uzel, 1895.

2. *Æolothrips brevicornis*, Bagnall.

One ♀ specimen taken at Mossel Bay, Cape Province, viii. 1924 (Moulton no. 2845); one ♀ at Goerge, Cape Province, vii. 1920 (no. 2855); one ♀ taken at Drakensberg, Natal, in 1926, elevation 6500 feet (*R. E. Turner*) (no. 2874). Specimens nos. 2855 and 2874 deposited with the British Museum, no. 2845 in author's collection.

3. *Æolothrips scabiosatibia*, sp. n.

Female holotype.—Colour uniformly dark brown, except segment 3 of antenna, extreme tip of 2, tarsi, and the median

portion of fore tibiæ, which are yellowish. Fore wings with two dark cross-bands, hind wings without noticeable colouring.

Total body-length 1·66 mm. (somewhat distended); head, length ·16 mm. (head-length of paratype ·15 mm., width ·18 mm.); prothorax, length ·15 mm., width ·25 mm. Antennæ: length (width) i. 24 (30), ii. 48 (27), iii. 75 (24), iv. 60 (27), v. 60 (27), vi–ix. combined 39 μ; total length 316 μ.

This species is closely related to *Æolothrips brunicornis*, Bagnall, in that each fore wing has two dark cross-bands, typical of the *A. fasciatus*-group, antennal segments 6–9 are subequal and together, like *A. brevicornis*, are much shorter than 5, segments 4 and 5 are subequal, and about four-fifths as long as segment 3. Entire antenna is moderately stout and approximately twice as long as head; sense-areas on segments 3 and 4 moderately broad, extending two-thirds the length of the segments. This species is especially characterized by the unusually roughened fore tibiæ, which are normally spiny on the dorsal side, but on the ventral side each spine arises from the side of a small wart or tubercle, which makes the surface of the tibiæ extremely rough. The spines of the middle and hind tibiæ are normal; unfortunately the fore tibiæ are broken from the second paratype, but after measurement and comparison I have referred the second paratype to this species rather than to *brevicornis*.

Type-material.—Female holotype (Moulton no. 2905); two ♀ paratypes (nos. 2902 and 2904), collected from an unknown host-plant in iv. 1925 (*R. E. Turner*). Holotype and one paratype deposited with British Museum, one paratype in author's collection.

Type-locality.—Ceres, Cape Province, South Africa.

4. *Rhiphidothrips turneri*, sp. n.

Male holotype.—Colour uniformly dark brown except tips of second and third antennal segments, which are lighter (unfortunately the antenna is broken off beyond the second segment, but the third and fourth segments of one antenna are present, though detached; the fore and middle pair of legs are also lost). Hind legs uniformly dark brown like the body. Wings whitish in basal quarter, with uniformly dark brown band across the second and third quarters, a white band across the first half of the last quarter, with tip of wing brown like the median portion, posterior pair of wings banded like the anterior pair but less distinctly.

Total body-length 1·33 mm. Antennæ: length (width) i. 36 (36), ii. 45 (30), iii. 105 (30), iv. 105 (27) μ.

Head somewhat longer than wide; cheeks straight, without prominent spines.

Prothorax only slightly wider than head. Pterothorax elongate-ovate. Wings clearly narrowed in basal quarter, gradually becoming wider to near middle, distal half of wing with sides almost parallel. Sternites without depressions.

Type-material.—Male allotype (Moulton no. 2835), taken on an unknown host-plant, 20.iii.1927 (*R. E. Turner*). Holotype deposited with the British Museum.

Type-locality.—Harrismith, Orange Free State, South Africa.

The single specimen before me is distinct from other species of the genus by its broadly banded wings approaching only *R. cinctus*, Hood, from Queensland, Australia, but differing from this by the much broader median band. This species is also interesting because it is the first of the genus recorded from South Africa.

Family **Franklinothripidæ**, Bagnall, 1926.

5. *Franklinothrips megalops*, Trybom.

Nine ♀ specimens taken at Mossel Bay, Cape Province, South Africa, iv.1921 and ii. 1922 (*R. E. Turner*).

Superfamily **THRIPOIDEA**, Hood.

Family **Thripidæ**, Uzel, 1895.

Subfamily *HELIOTHRIPINÆ*, Karny.

6. *Hercothrips bicinctus*, Bagnall.

One ♀ specimen taken at Eshowe, Zululand, South Africa, v.1926 (*R. E. Turner*) (Moulton no. 2869).

For diagnosis of this genus see Hood, 'Psyche,' vol. xxxiv. no. 6, Dec. 1927.

Subfamily *SERICOTHRIPINÆ*, Karny.

7. *Sericothrips occipitalis*, Hood.

Eight female and two male specimens collected from bean-foliage, 10.iv.1922 (*A. Cuthbertson*), at the Agricultural Experiment Station, Salisbury, South Africa.

The specimens from which this species was described were found at Ibadan, Southern Nigeria, and the present record extends its distribution into South Africa.

Two specimens deposited with British Museum (Moulton, no. 1640).

8. *Scirtothrips pomeroyi*, sp. n.

Female holotype.—Colour uniformly light yellow except wings, antennal segments 1 and 3, which are whitish yellow, and distal two-thirds of 6, 7, and 8, which are greyish brown; 4 and 5 also have a shading of greyish brown on upper and lower sides of distal two-thirds. Crescents of ocelli orange-red.

Total body-length ·916 mm.; head, length ·069 mm., width across at eyes ·10 mm.; prothorax, length ·144 mm., greatest width across posterior fourth ·135 mm.; pterothorax, width ·168 mm.; abdomen, width ·21 mm. Antennæ: length (width) i. 15 (24), ii. 30 (22), iii. 33 (18), iv. 33 (18), v. 30 (18), vi. 36 (15), vii. 9, viii. 10; total length 195 μ.

Head clearly transverse, rounded in front; cheeks short, slightly converging toward the posterior. Interocellar spines small and placed almost directly in front of posterior ocelli, other head-spines inconspicuous. Eyes large, occupying more than half the length of the head. Ocelli fully developed. Mouth-cone long, pointed, reaching four-fifths across prosternum. Maxillary palpi 3-segmented. Antenna 2·8 times as long as head, segment 3 broadly clavate, 4 and 5 subovate, each with a small pedicel.

Prothorax slightly longer than greatest width and slightly more than twice as long as head, sides gradually diverging to near posterior fourth, from there converging to form broadly rounded angles. Spines on anterior angles vestigial, with a single prominent, though short, spine on each posterior angle, and a series of four small ones along posterior margin on either side. Pterothorax only slightly wider than prothorax. Sides of mesothorax broadly rounded, of metathorax straight and almost parallel. Legs normal. Wings fully developed, fore longitudinal vein fairly distinct. Spines as follows:—3—3 at base and three evenly placed over distal half, the first one being near the centre of the wing; hind vein very indistinct, but with three scattered bristles near centre of wing and one near tip where vein should be.

Abdomen elongate-ovate, with last three segments rather pointed, conical, without pubescence. Posterior margin of eighth tergite without cone. Longest spines on segments 9 and 10 approximately 75 μ, segment 10 with dorsal suture.

This species is distinct from all other members of the genus so far described by its unusually long prothorax, suggestive of the genus *Stenothrips*, Uzel, but the 8-segmented antenna and 3-segmented maxillary palpus clearly removes this species from that genus.

Type-material.—Female holotype, three female paratypes, one paratype taken on the leaf-buds of *Vitex* sp. (Moulton no. 2342), the others including holotype from an unknown host-plant (no. 2344), ii.1927 (*A. W. J. Pomeroy*). Holotype in author's collection, one paratype deposited with the British Museum.

Type-locality.—Yegi, Volta River, N. Ter., Gold Coast, Africa.

9. *Scirtothrips acaciæ*, sp. n.

Female holotype.—Colour whitish yellow. Abdominal segments 3 to 8 with a distinct brown line across median third of anterior margin. Antennal segment 1 whitish, 2 to 8 greyish brown, terminal segments being somewhat darker than 2 and 3. Fore wings light greyish brown, hind wings whitish, each with a dark grey-brown median line. Crescents of ocelli orange-red.

Total body-length ·83 mm.; head, length ·084 mm., width ·129 mm.; prothorax, length ·105 mm., width ·156 mm.; mesothorax, width ·195 mm.; abdomen ·210 mm. Antennæ: length (width) i. 12 (24), ii. 30? (24), iii. 42 (21), iv. 42 (20), v. 36 (15), vi. 33 (15), vii. 6, viii. 12; total length 210 μ. Length of spines: anteocellar 15 μ, ninth abdominal segment 45 μ, tenth 48 μ.

Head clearly transverse, vertex with a series of transverse lines occupying the entire area between posterior margin of ocelli and eyes to posterior margin of head; they are closely placed, clearly defined, and are not confluent. Eyes large. Ocelli well developed. Mouth-cone rather short, extending two-thirds over prosternum, almost triangular in shape, maxillary palpus with three segments.

Prothorax with sides arched, uniformly lined over entire surface as on vertex of head, without prominent spines at angles, but with three on either side along posterior margin, the outermost of which could be classed as an angular spine. Legs normal. Wings fully developed, fore-vein indistinct, but with spines as follows:—3—4 to 6 in basal half, three scattered over distal half, posterior vein not apparent but with three scattered over distal half of wing where vein should be.

Abdomen pubescent along the sides, with fully developed comb along posterior margin of segment 8.

This species is more closely related to *S. australis*, Hood, from Australia, and *S. dorsalis*, Hood, from India. In *S. australis* the dark basal line extends entirely across abdominal segments 3 to 7. Ocelli are dark yellowish in colour and the bristles on the fore vein of fore wings are arranged as follows:—three in basal fourth, two in second fourth, one at middle, and two at tip. In *S. dorsalis*, Hood, each dark line on abdominal segments 3 to 8 is followed by a brown patch, crescents of ocelli are bright red in colour and the fore vein of fore wing has three spines at base, an intermission, one in the middle, and two at tip. In this new species the dorsal line on abdominal segments 3 to 8 occupies only about the median third of the segment, and is followed only by the faintest suggestion of a cloud; ocelli are bright orange-red, but more particularly the spines on the fore vein of the fore wing are arranged as follows:—three at base, an intermission followed by a group of four to six, and three evenly placed in distal half.

Type-material.—Holotype collected from *Acacia siberiana*, ii.1927 (*A. W. J. Pomeroy*) (Moulton, no. 2341). (Holotype in author's collection.)

Type-locality.—Yegi, Volta River, N. Ter., Gold Coast, Africa.

10. *Anaphothrips cuthbertsoni*, sp. n.

Female holotype.—Colour uniformly dark orange-brown; antennal segments 1 and 2 concolorous with head (other segments lost). Legs yellowish, with a slight shading of brown on the femora. Wings uniformly light brown. Crescents of ocelli orange-red.

Total body-length ·96 mm.; head, length ·096 mm., width ·12 mm.; prothorax, length ·12 mm., width ·15 mm.; mesothorax, width ·216 mm.; metathorax, width ·195 mm.; greatest width of abdomen ·22 mm. Longest spines on ninth abdominal segment 51 μ.

Head transverse, depressed in front between eyes, with numerous cross wrinkles behind eyes, without conspicuous spines. Eyes prominent. Ocelli well developed. Mouth-cone reasonably short.

Prothorax without prominent spines at angles and with very indistinct transverse wrinkles. Mesothorax wider than metathorax. Legs small. Wings fully developed, with two longitudinal veins, all spines extremely small and in length less than one-eighth the width of the wing; costa with 21,

fore vein 3—3 at base, one near the middle, and two near tip, hind vein with twelve evenly placed spines. Last five segments of abdomen clearly reduced, segment 10 small, narrowed, conical, with dorsal suture over three-fourths its length. Comb along posterior margin of eighth segment weak and sparse. Spines on segment 9 relatively short, not any longer than the segment itself.

This species may be separated from *A. ferrugineus*, Uzel, which it closely resembles, by the regular placement of spines on the hind vein of fore wing; also the longest spines on abdominal segment 9 do not exceed 60 μ, while in *ferrugineus* they are 75 μ or more.

Type-material.—Female holotype taken on *Bidens pilosa* and "Black Jack" on the Sinoia Citrus Estate, 15.ix.1926 (Moulton, no. 1641) (*A. Cuthbertson*). Holotype in author's collection.

Type-locality.—Rhodesia, South Africa.

Subfamily *Thripinæ*, Karny.

11. *Frankliniella schultzei*, Trybom.

I am placing here, tentatively, a series of specimens, 4 ♀ ♀ taken on orange, Rhodesia (*A. Cuthbertson*) (Moulton, no. 1351); 12 ♀ ♀, 10 ♂ ♂, taken on *Icacina svengalensis* (no. 2340); 2 ♀ ♀, 2 ♂ ♂, taken on *Vitex* sp.; 1 ♀, 1 ♂, on *Lawsonia alba* (no. 2343); 1 ♂ from an unknown host (no. 2344), taken at Yegi, Gold Coast, West Africa (*A. W. J. Pomeroy*).

These specimens are especially characterized by the interocellar bristles being placed between the posterior ocelli 12 to 15 μ apart; cheeks converging as in the American species *F. insularis*; pits on the antennal segment which receive the sense-cones are long, narrow, and not round or oblong as are many species; the colour varies from almost clear yellow to yellowish-orange thorax and brown abdomen, or to deep brown.

12. *Tæniothrips sjostedti*, Trybom.

One ♀ specimen taken in orange-blossoms (*R. W. Jack*) (Moulton no. 1348) and 14 ♀ ♀ taken on cowpeas (*A. Cuthbertson*) (no. 1349), both collections made 24.iv.1926 at Mozae, Southern Rhodesia.

I am able to supplement Trybom's description by the following:—interocellar spines placed forward and slightly inward from the posterior ocelli, the distance between them

being about 36 μ; antennal segment 4 with a rudimentary dorsal sense-cone in addition to the large forked one on the ventral side; comb along posterior margin of abdominal segment 8 developed at the sides, but absent in the middle; segment 10 with dorsal suture extending only to base of prominent spines.

13. *Tæniothrips pictus*, Hood.

Two ♀♀ taken in orange-blossoms, 24.iv.1926, at Mozae, Rhodesia (*R. W. Jack*).

14. *Tæniothrips umtalii*, sp. n.

Female holotype.—Colour dark brown, with head lighter in the area around ocelli. Pterothorax orange-brown and abdominal segments 2 to 8 with a distinct dark brown line near anterior margin. Antenna dark brown except segment 3, which is yellowish brown in basal half, shading to greyish brown in distal half, and base of 4, which is somewhat lighter. Crescents of ocelli orange-red. Legs yellowish, with all femora shaded brown on outer margins. Wings clear in basal quarter, uniformly greyish brown in distal three-quarters. Body and wing-spines dark brown.

Total body-length 1·36 mm.; head, length ·12 mm., width ·135 mm.; prothorax, length ·126 mm., width ·18 mm.; pterothorax, width ·216 mm.; greatest width of abdomen ·23 mm. Antennæ: length (width) iii. 48 (24), iv. 45 (24), v. 30 (19), vi. 45 (19), vii. 7, viii. 7; total length 270 μ. Length of spines: on posterior angles of prothorax subequal, 39 μ; longest spines on ninth abdominal segment 75 μ, on tenth 84 μ.

Head almost as long as wide, cheeks arched, all spines inconspicuous. Vertex broadly, transversely striate. Interocellar spines small, placed in front of posterior ocelli and in the middle of a line connecting outer margins of anterior and posterior ocelli, and placed approximately 27 μ apart. Eyes large, with coarse facets, occupying half the length of the head. Ocelli large, fully developed. Mouth-cone short. Maxillary palpus small, with segments subequal. Antenna relatively stout, 2·2 times as long as head, segments 3 and, 4 broadly clavate and not noticeably constricted toward their tips. Style very short, segments subequal and together about one-fourth the length of segment 6, forked sense-cones on segments 3 and 4 normal.

Prothorax ·7 as long as wide, spines at posterior angles subequal, short, and moderately stout. A series of four on

either side along posterior margin, gradually increasing in length from the shorter outer to the longer inner ones. Two pairs of spines on metanotal plate—an outer anterior pair placed near anterior margin, and the second or inner pair placed 18 μ away from margin and 15 μ apart. Legs relatively small. Wings fully developed, gradually decreasing in size from the broad base to the rather narrow tip. Spines as follows:—costa 32, fore vein with 4 or 5—3 at base and three near tip, hind vein with 16 regularly placed spines.

Abdomen long and slender, comb along posterior margin of segment 8 fully developed, but sparse; suture on segment 10 extending to halfway between base of prominent spines and anterior margin of segment; spines on segment 9 somewhat shorter than those on 10.

This species is closely related to *T. gowdeyi*, Bagnall, but may be distinguished by its somewhat larger size, relatively longer head, the small style with segments of equal length, and the larger number of wing-spines, especially on the costa.

Type-material.—Holotype and four ♀ paratypes taken on *Blumea* sp. and on a *Persicaria*-like herb, 5.x.1926 (*A. Cuthbertson*) (Moulton no. 1642). Holotype in author's collection, and one paratype deposited with the British Museum.

Type-locality.—Rhodesia, South Africa.

15. *Tæniothrips crassiconus*, sp. n.

Female holotype.—Body-colour uniformly brown. Antennal segments 1, 2, 6 to 8 concolorous with head, except tip of 2, which is somewhat lighter; 3, 4, and 5 light brownish yellow, with 4 and 5 very slightly darkened in outer portions. All femora brown, fore tibiæ brownish yellow, middle and hind tibiæ dark brown except extreme tips and all tarsi, which are light yellow. Fore wings uniformly greyish brown, with only a slightly washed-out area at base. Ocelli deep orange-red.

Total body-length ·96 mm.; head, length ·072 mm., width ·12 mm.; prothorax, length ·147 mm., width ·15 mm. Antennæ: length (width) iii. 39 (24), iv. 48 (22), v. 36 (18), vi. 48 (18), vii. 11, viii. 18; total length 240 μ. Length of spines: interocellar 39 μ, on posterior angles of prothorax, outer 39 μ, inner 45 μ, on ninth and tenth abdominal segments subequal, 90 μ.

Head transverse; cheeks slightly arched and constricted toward posterior margin, vertex roughened by strong transverse wrinkles. Interocellar spines strong and placed between posterior ocelli, and only about 12 μ apart. Eyes large and

occupying about ·6 the side of the head. Ocelli fully developed. Mouth-cone very long and slender, reaching to near posterior margin of prosternum. Maxillary palpus long and slender, with basal segment much longer than other two, their respective lengths being, first 30, second 18, and third 15 μ, total 63 μ. Antennal segment 3 pediculate and broadly ovate and ·6 as wide as long, segment 4 broadest near middle and then gradually narrowed to moderately broad tip. This reduction in size is gradual, however, and not constricted neck-like as in many species. Style long and slender, the end segment much the longer, and together ·62 as long as segment 6; forked sense-cones on segments 3 and 4 moderately short and unusually stout.

Prothorax noticeably elongate and fully ·5 longer than head. Spines on posterior angles subequal, short and stout, a series of three on either side along posterior margin of about equal length or the innermost somewhat stronger. Two pairs of spines on metanotum placed near anterior margin, the innermost pair 30 μ apart. Legs normal. Wings with spines as follows :—costa 28, fore vein, a group of four at base, an intermission and a series of ten beginning at basal quarter and extending almost to beginning of distal third, an intermission and three scattered spines in distal quarter, hind vein with a series of twelve spines beginning at basal third and opposite a point midway between second and third spines in large series of fore vein. Spines on wing moderately short and stout, and the distance between base of end spine in first group of fore vein and first spine in series on hind vein approximately the length of four bristles.

Abdomen elongate-ovate, without comb along posterior margin of segment 8. Dorsal suture on segment 10 extending to halfway between base of prominent spines and anterior margin. Spines on segments 9 and 10 subequal and rather short.

This species, because of the position and arrangement of spines on fore wing, should be placed in the *T. usitatus*, Bagnall, group, but it is clearly distinguished from both *usitatus* and *variabilis*, Bagnall, by its uniformly brown-coloured wings beyond the basal quarter.

Type-material.—Holotype and six ♀ paratypes taken from *Acacia sieberiana* (Moulton no. 2341), *Vitex* sp. (no. 2342), and from an unknown host (no. 2344) in ii.1927 (*A. W. J. Pomeroy*). Holotype in author's collection, paratype deposited with the British Museum, London.

Type-locality.—Yegi, Gold Coast, West Africa.

16. *Thrips tabaci*, Lind.

One ♀ specimen taken in Eshowe, Zululand, South Africa, v.1926 (*R. E. Turner*) (Moulton no. 2867).

Subfamily *Mycterothripinæ*.

17. *Mycterothrips flavens*, sp. n.

Female holotype.—Colour: head and abdomen light yellow, thorax light orange-yellow. Antennal segment 1 clear whitish yellow, lighter than the head, 2 to 5 each shaded brownish grey in outer portion and yellowish at base, 6 to 8 greyish brown. Legs and wings uniformly yellowish white. Prominent spines on body, especially along the sides of the abdomen and on wings, noticeably dark brown. Ocelli bright orange-red.

Total body-length ·83 mm.; head, length ·066 mm., width ·108 mm.; prothorax, length ·144 mm., width ·126 mm.; mesothorax, width ·183 mm.; metathorax, width ·162 mm.; greatest width of abdomen ·234 mm. Antennæ: length (width) i. 18 (21), ii. 33 (21), iii. 45 (18), iv. 45 (18), v. 27 (15), vi. 48 (18), vii. 9, viii. 15; total length 237 μ. Length of spines: interocellars 30 μ, on posterior angles of prothorax, outer 36, inner 27 μ, innermost along posterior margin 24 μ, innermost along anterior margin of metanotum 30 μ, outer margin on ninth abdominal segment 75 μ, on tenth segment 80 μ.

Head clearly transverse, vertex weakly cross-striate, interocellar spines prominent, dark brown in colour and placed between the posterior ocelli on a line connecting their anterior margins. Eyes prominent, slightly protruding, occupying more than half the side of the head. Ocelli fully developed. Mouth-cone long, very slender, pointed, reaching past posterior margin of prosternum. Antennæ more than three times as long as head, segments 3 and 4 each broadly constricted in outer third, 4 pediculate almost as clearly as segment 3, segment 5 also shortly pediculate, segment 8 noticeably longer than 7, forked sense-cones on segments 3 and 4. Maxillary palpus with three segments.

Prothorax subrectangular, clearly longer than wide, and slightly more than twice as long as head, without prominent spines at anterior angles, but with a pair of spines at each posterior angle, and inward from these two on either side along posterior margin, the inner pair of which is somewhat larger than the outer. Surface of pronotum sparsely spinose, but without other lines or markings. Sides of mesothorax

round; metathorax smaller, with sides almost parallel except at the posterior rounded angles. Legs moderately long and slender. Wings fully developed with ring-veins; two longitudinal veins which are fused with ring-vein at the end of the wing, and two cross-veins connecting costa with fore longitudinal veins, all veins clearly developed and distinct, with spines as follows:—costa 22, fore vein with four—three at base and two at tip; hind vein with thirteen regularly placed spines.

Abdomen elongate-ovate, with two or three prominent though rather short dark-coloured spines at the side of each segment, also with a covering of extremely fine microscopic setæ along sides, which are difficult to see; posterior margin of segment 8 with long clearly-defined comb. Spines on segments 9 and 10 about as long as the segments themselves. Segment 10 apparently without dorsal suture, but this cannot be determined with certainty.

This species is easily distinguished from *M. setiprivus*, Karny, by the presence of twelve spines on hind vein of fore wing as compared with four on the other species, and from *M. longirostrum*, Jones, which has four spines on distal part of fore vein instead of two.

Type-material.—Holotype, 4 ♀ paratypes taken on *Acacia sieberiana*, ii.1927 (*A. W. J. Pomeroy*) (Moulton no. 2341). Holotype in author's collection, one paratype deposited with the British Museum.

Type-locality.—Yegi, Gold Coast, Africa.

XV.—*A new Colubrine Snake from Eucador.* By H. W. Parker, B.A.

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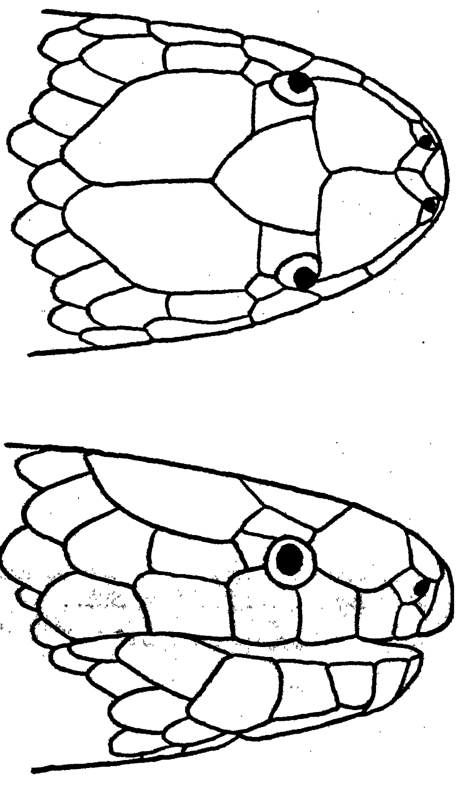
The author is indebted to Professor Clodoveo Carrion for the privilege of examining an interesting collection of reptiles and amphibians made in the vicinity of the City of Loja, S. Ecuador. Amongst this collection, from which many valuable specimens have been presented to the British Museum, are two aglyphous colubrine snakes which appear to represent an undescribed species of the genus *Atractus*. The new species differs from all the other members of this genus in lacking a loreal shield; but, since there is a large amount of variation in the size of this shield amongst the previously known species, it appears desirable to extend the limits of the genus slightly rather than create a new genus on

such a trivial difference. In all other characters the species is a true *Atractus*, without vertebral hypapophyses posteriorly, with nine or ten maxillary and a similar number of mandibular teeth both enlarged anteriorly and decreasing regularly behind, a small eye with vertically subelliptic pupil, smooth, pitless scales, and the nostril situated between two nasals; apart from the absence of the loreal, it appears to be mostly closely allied in other characters to *A. boettgeri*, Boulenger, and *A. roulei*, Despax.



Atractus carrioni, sp. n.

Atractus carrioni, sp. n.

Holotype (a female), number 1929. 10. 30. 1 in the British Museum; collected in Loja, Ecuador (2200 metres), by Professor Clodoveo Carrion.

Head not distinct from neck; snout rounded. Rostral nearly as deep as broad, the portion visible from above less

than half as long as its distance from the frontal; internasals very small, longer than broad; præfrontals large, in contact with the second and third labials, as long as the frontal, which is as long as its distance from the rostral and about half as long as the parietals; no loreal; no præocular; supraocular small; one postocular; temporals 1+1; six upper labials, the third and fourth entering the eye; four lower labials in contact with the single large pair of chin-shields; first lower labial in contact with its fellow behind the symphysial. Scales in 15 rows; ventrals 159; anal entire; subcaudals 26 pairs+1.

Iridescent purplish black above; belly black, the outer ends of the ventrals irregularly mottled with white; upper lip, chin, throat, and anal shield white.

Length from snout to vent 480 mm.; tail 49 mm.

Paratype (a male from the type-locality), in Professor Carrion's collection. This specimen differs from the holotype in some details. There are two postoculars on one side, 149 ventrals, 30 pairs of subcaudals, the anal shield is not so markedly white and its size is smaller.

Length from snout to vent 295 mm.; tail 44 mm.

XVI.—*Some Entomostraca from Skye, with Notes on the Resting Eggs of* Cyclops pictus, *Koch.* By A. G. Lowndes, M.A., F.L.S.

In a recent paper (1) I recorded some species of Copepoda and Cladocera found in the Cuillin Hills of Skye. This work was really carried out as a part of an investigation on the influence of pH on the various species, but as, apparently, there were no previous records of the freshwater Entomostraca of Skye, it was thought advisable to make a further investigation, and I accordingly spent nearly three weeks of April this year in Skye, and collected in the Broadford district.

The Broadford district is, of course, very different to that of the Cuillin Hills, and contains several fairly large lochs instead of isolated rock-basins.

Lochs Cill Chriosd, Lonachan, an Eilein, and Loch Buidhe were all visited, as well as a loch on Cnoc Carnach and a small pond on the road to Heast.

The work was chiefly confined to Copepoda, but the Cladocera and a few of the Ostracoda were also noted.

The following list gives the species found:—

COPEPODA.

Diaptomus gracilis, Sars.
—— *laticeps*, Sars.
—— *laciniatus*, Lilljeborg.
Canthocamptus staphylinus, Jurine.
Attheyella pygmæa, Sars.
—— *zschokkei*, Schmeil.
—— *crassa*, Sars.
Cyclops pictus, Koch.
—— *vulgaris*, Koch.
—— *nanus*, Sars.
Cyclops pulchellus, Koch.
—— *lucidulus*, Koch.
Pachycyclops annulicornis, Koch.
—— *signatus*, Koch.
Leptocyclops agilis, Koch.
—— *macruroides*, Lilljeborg.
—— *prasinus*, Fischer.
Platycyclops fimbriatus, Fischer.
—— *affinis*, Sars.

CLADOCERA.

Daphnia pulex (De Geer).
—— *longispina*, O. F. Müller.
Ceriodaphnia laticaudata, P. E. Müller.
Bosminia obtusirostris, Sars.
Eurycercus lamellatus, O. F. Müller.
Acroperus harpæ, Baird.
Alona affinis, Leydig.
Alonopsis elongata, Sars.
Peratacantha truncata, O. F. Müller.
Pleuroxus trigonellus, O. F. Müller.
Chydorus piger, Sars.
—— *sphæricus*, O. F. Müller.

OSTRACODA.

Candona candida.
Cyclocypris lævis, O. F. Müller.
Cypria ophthalmica, Jurine.
Limnicythere inopinata, Baird.

In addition to the lochs of the Broadford district I visited Loch Coruisk, and spent several hours dragging a 12-inch net through at various depths.

It is unnecessary to give a full description of all the various lochs, as they are very much the same, and only two of these, in addition to Loch Coruisk, need be considered.

Loch Lonachan.

This is a fairly large loch, being nearly a mile long. It is at a height of 500 feet above sea-level, and lies in a hollow above the old marble-quarries. The water is remarkably clear, and there is very little vegetation in the actual loch, though there is a fairly thick patch of *Scirpus lacustris* at the southern end, while the northern end is silted up.

The depth is not much more than 20 feet.

Entomostraca were very abundant in this loch, and a 12-inch net dragged for five minutes through the water even at the surface produced great quantities of specimens. The most abundant species by far was the very beautiful Calanoid *Diaptomus laticeps*, and after this in abundance came *Cyclops pictus* and then *Daphnia longispina*. Insects, either adult

or larvæ, were not abundant. *Gammarus pulex* and a few specimens of *Limnea peregra* were also found. It is noteworthy that this loch is by far the best in the district, so I am told, for small trout.

The following species of Entomostraca were recorded:—

Cyclops pictus.	*Alona affinis.*
—— *vulgaris.*	*Peratacantha truncata.*
Leptocyclops agilis.	*Alonopsis elongata.*
—— *macruroides.*	*Acroperus harpæ.*
Pachycyclops annulicornis.	*Eurycercus lamellatus.*
—— *signatus.*	*Chydorus piger.*
Platycyclops fimbriatus.	—— *sphæricus.*
—— *affinis.*	*Cyclocypris lævis.*
Daphnia longispina.	*Limnicythere inopinata.*
Ceriodaphnia laticaudata.	

Loch an Eilein.

This loch is very similar to Loch Lonachan, and its fauna, so far as I was able to investigate it, was identical, the most prevalent species of Entomostraca being again the Calanoid *Diaptomus laticeps.* The loch is rather smaller, and, as its name implies, it contains small islands.

Loch Buidhe.

This loch is very much silted up at its south-west corner, where it forms two small lochs. Towards the Broadford end it opens out and becomes clearer and deeper. Here *Diaptomus laticeps* is replaced by another species, *Diaptomus laciniatus.*

Loch on Cnoc Carbach.

This is an isolated loch, and quite small and largely surrounded by igneous rock, namely, the Cnoc Carnach granophyre. At the south-west corner the lake seems to have been held back by drift and peat.

The Amphipod *Gammarus pulex* was very abundant here, and it was difficult to prevent it becoming a nuisance when collecting. The Calanoid here was *Diaptomus gracilis,* which was the most abundant species of Entomostraca.

In addition, *Cyclops pictus, Leptocyclops agilis, Pachycyclops annulicornis,* and *Bosminia obtusirostris* occurred.

Loch Cill Chriosd.

This loch is quite different from the others. It is considerably larger, lies much lower, much less isolated, and is

very much more silted up. It is quite obvious that at one time this loch must have extended to Kilbride, and thus have been quite twice its present length. There is a great deal of vegetation, including large masses of *Scirpus lacustris* and *Phragmites communis.* The loch is nowhere deep, being less than 10 feet in its deepest part. I am informed that the fish in this loch are always large, and quite a number of salmon are caught there.

It is rather interesting to note that no species of *Diaptomus* occurred there, and by far the most abundant Entomostracan was one of the Cladocera—*Bosminia obtusirostris,*—and this occurred in large quantities.

The following is a list of the species found:—

Cyclops vulgaris.	*Acroperus harpæ.*
— *lucidulus.*	*Alonopsis elongata.*
Leptocyclops agilis.	*Bosminia obtusirostris.*
Pachycyclops annulicornis.	*Pleuroxus trigonellus.*
—— *signatus.*	*Alona affinis.*
Platycyclops affinis.	*Candona candida.*
Attheyella crassa.	*Cyclocypris lævis.*

Loch Coruisk.

This is the largest and deepest freshwater loch in Skye, and it is probably the most isolated. There is no road within miles, and the only ways of approach are a 10-mile walk from Sligachan or a 6-mile walk from Elgol, with the possible alternative of a 6-mile walk from Strathaird House through Camasunary and over the Bad Step. Obviously none of these ways are without difficulties when one has to carry apparatus, and it is not possible to get to the loch for more than a very few hours. Finally, there is the question of a boat on the loch, since one cannot do much on a loch over 2 miles long and 125 feet deep without one.

Obviously the loch is too unique to be left out of any attempt at a survey of the freshwater Entomostraca of Skye, and I was most fortunate in obtaining the interest and help of Mr. W. H. Johnson, who owns the estate. Mr. Johnson was good enough to instruct three of his men to take a boat round from Camasunary and to pull it up over the rocks to the loch. In this way I was able to explore the deepest parts of the loch with a 12-inch open net.

Unfortunately the result was, in a way, most disappointing. The water is very clear, and there is an abundant rainfall, and, in addition, there must be normally a pretty strong outflow, with the result that very little was to be found.

On dragging the net for fifteen minutes at the surface only a few specimens of *Cyclops pictus* were caught, whereas the same net dragged for the same time through Loch Lonachan produced enough material to give a bottle holding about 250 c.c. the appearance of a solid mass of Entomostraca. Hauls were then made at greater depths, and the number of specimens increased; but on no occasion was the material obtained abundant.

The only species of Entomostraca were *Cyclops pictus*, *C. vulgaris*, and *Bosminia obtusirostris*.

General Remarks.

Combining the work done in the Cuillin Hills with that of the Broadford district, we get the following list of species of Entomostraca:—

Diaptomus gracilis, Sars.
—— *laciniatus*, Lillejeborg.
—— *laticeps*, Sars.
Canthocamptus staphylinus, Jurine.
Attheyella pygmæa, Sars.
—— *zschokkei*, Schmeil.
—— *crassa*, Sars.
Cyclops pictus, Koch.
—— *vulgaris*, Koch.
—— *nanus*, Sars.
—— *pulchellus*, Koch.
—— *lucidulus*, Koch.
—— *bisetosus*, Rehberg.
—— *languidus*, Sars.
Pachycyclops annulicornis, Koch.
—— *signatus*, Koch.
Leptocyclops agilis, Koch.
—— *macrurus*, Sars.
—— *macruroides*, Lilljeborg.
—— *lilljeborgi*, Sars.
—— *prasinus*, Fischer.
Platycyclops affinis, Sars.
—— *fimbriatus*, Fischer.
Sida crystallina (O. F. Müller).
Latona setifera (O. F. Müller).
Daphnia pulex (De Geer).
—— *longispina*, O. F. Müller.
Ceriodaphnia laticaudata, P. E Müller.
—— *quadrangulata* (O. F. Müller).
Bosminia obtusirostris, G. O. Sars.
Drepanothrix dentata (H. A. Eurén).
Acantholebris curvirostris, O. F. Müller.
Eurycercus lamellatus, O. F. Müller.
Acroperus harpæ, Baird.
Alonopsis elongata, Sars.
Alona affinis (Leydig).
Alonella nana (Baird).
—— *excisa* (Fischer).
Peratacantha truncata (O. F. Müller).
Pleuroxus trigonellus (O. F. Müller).
Chydorus latus, Sars.
—— *piger*, Sars.
—— *sphæricus* (O. F. Müller).
Polyphemus pediculus (Linné).
Candona candida (O. F. Müller).
Cyclocypris lævis (O. F. Müller).
Cypria ophthalmica (Jurine).
Limnicythere inopinata (Baird).

In addition, the following Harpacticids were found in fresh or brackish water close to the shore:—

Tigriopus fulvus (Fischer).
Mesochra lilljeborgi, Boeck.

Taken on the whole, the above list contains little of special interest. Among the Copepods it is rather remarkable

that no species of the genus *Mesocyclops* was found, and the same applies to *Cryptocyclops*. *Diaptomus castor* was not found, but this seems to be comparatively rare in Scotland.

Pachycyclops bistriatus is another species that has not yet been recorded from Skye, and this point is of some significance, since it has been claimed by some Copepod systematists to be a hybrid between *P. annulicornis* and *P. signatus*, both of which occur plentifully in the island.

In my previous paper I recorded *Cyclops robustus*, Sars, but I have since shown that it is not a separate species, only a form of *C. lucidulus*, Koch (2).

It was observed that no two species of *Diaptomus* occurred in one and the same pond or tarn, and this is rather remarkable, since three species occurred quite abundantly, and all three seem to appear under very similar conditions. I have never found *Diaptomus castor* and *D. gracilis* together in the South of England, but this point would appear to be of little significance, since the two species are rather distinct in their habitat.

When we turn, on the other hand, to the Cyclopids and Harpacticids we find a most bewildering number of associations, nor is it incorrect to say that we frequently find the most closely allied species of a genus, so far as they are known, side by side in one and the same pond.

There is, in reality, little or no significance in this apparent isolation of the species of *Diaptomus*, for on examining material collected from South America, where the genus *Diaptomus* seems to be remarkably well represented, one practically always finds three or four species in one and the same collection. One point I would stress to the utmost, and that is, the danger of drawing conclusions from negative results, such as the absence of certain species from various collections. No matter how good the collector may be, he cannot expect to obtain all that there is to be obtained from any locality by a casual visit, or even by staying in one district for a few weeks. It is the experience of many collectors that after they have been in one district for a considerable number of years, and made pretty continuous collections from one spot, that a species will turn up. Either it has just arrived by some unknown process or the systematist has missed it, and one would doubt, therefore, whether the collections so frequently made by those with little or no experience of the various groups can be of much value from an ecological point of view.

Cyclops pictus, Koch.

One observation on this very common and well-known species may prove to be of considerable importance.

On examining specimens from Loch Lonachan it was observed that the ovisacs of the females contained very few eggs, usually not more than six each, and the eggs appeared to be unusually large. Some collections of Entomostraca were taken from Loch Lonachan and sent back to Marlborough in the living state, and many specimens of the *Cyclops pictus* in question were alive when I arrived ten days later.

I separated a number of these, and waited for the nauplii to hatch out. I also measured the eggs and compared their size with those of the Marlborough specimens of the same species, and found that there was no great difference. I then made some observations on the times taken for the eggs to hatch out, and found these to be remarkably long, though, of course, one was working in the dark here, for if one takes a number of females with egg-sacs formed there is no reason to assume that those egg-sacs are all of the same age.

Usually it has been my experience and the experience of others that the eggs of *Cyclops* hatch within a couple of days, but in the case of the Skye specimens I found that even if the females were placed in an incubator at 20° C. the eggs took usually four days to hatch out. I then separated six females, and left them to hatch out their eggs under ordinary conditions. These females were separated on May 2nd, and one specimen died on May 4th; but the egg-sacs have remained attached and the eggs have not hatched out yet (June 12th). The eggs may be dead, but while the female has decomposed and left the exoskeleton only, the eggs have undergone no change, and there is no reason to suppose that they will not hatch out in time.

Another specimen gave a rather more definite result.

The female was separated on May 6th and left under ordinary conditions of temperature etc. It bore eggs, but, of course, their age was not known. After twenty-one days one of the eggs hatched out, while some six of them hatched out after twenty-four days. One egg still remains unhatched after thirty-seven days, while the female is still alive. Not only were the times taken for the eggs to hatch in a large number of specimens, but the nauplii were also carefully observed, in some cases within an hour of hatching, in order to see if they hatched at a more advanced stage; but it was

found quite definitely that this was not the case. Nauplii hatched from eggs that were known to have been in the egg-sacs for at least twenty-four days were quite definitely in the first nauplius-stage, showing the typical mandibular fork with only two setæ. I also compared the nauplii hatched out from these eggs with those just hatched out from the typical local specimens, and found no difference. Two further observations are of interest, but they require confirmation, having been observed in two or three specimens only. In the first case I have frequently found with the local species that as soon as one pair of egg-sacs are shed and the nauplii hatched out another pair takes its place without the male being present. Presumably the presence of sperms in the seminal receptacle is able to stimulate the formation of the egg-sacs and also to fertilize the eggs. In the Skye specimens with the delayed hatching of the eggs no second brood was observed. The second point is that in the local specimens the outer membrane—that composing the egg-sacs themselves—is apparently always shed; at least, this has been so in the specimens that I have hatched out myself during a fairly long series of breeding-experiments. In the Skye specimens the membrane is retained, and remains attached to the adult long after the eggs have hatched. What connection there is between this membrane and the long period taken for the eggs to hatch remains to be proved. The importance of the above observations will be recognized by those familiar with the freshwater Copepods, for while everyone recognized that *Cyclops* must have resting-eggs, no one has as yet been able to discover them. It may well be that the resting-eggs show no greater difference than the possession of a more resistant outer covering, and that the long resting-stage of the eggs is governed by the impermeability of that covering. Such a covering would, of course, protect the eggs from desiccation, and the covering itself may be correlated with the reduced number of eggs.

It should not be very difficult to investigate this matter pretty fully, but it requires a considerable amount of time, and in the absence of more direct evidence it is considered unwise to discuss it further.

One point is certainly partly cleared up, and that is the transference of specimens from one locality to another.

We know now quite definitely that the eggs in one species can remain in the resting-stage for at least twenty-four days, and it is quite obvious that they may be carried very far in that time. Again, it is more than probable that the adults may be swallowed by various water-fowl, and the eggs, with

their resistant covering, remain undigested, to be excreted far from their original station.

It is as well to bear in mind, however, one point in this connection. *Cyclops pictus*, Koch, the only species in which anything approaching resting-eggs has been observed, is not a cosmopolitan species. It occurs abundantly in the Arctic regions, but is not recorded further south than Northern India.

I wish to express my thanks to Captain Frank Shaw, of Corrie Lodge, and Mr. W. H. Johnson, of Strathaird, both for the use of the boats on the various lochs and permission to investigate those lochs of which they hold the fishing rights, etc.

REFERENCES.

(1) LOWNDES, A. G. "Copepoda and Cladocera of the Cuillin Hills of Skye." Ann. & Mag. Nat. Hist. ser. 10, vol. i. p. 461 (April 1928).

(2) ——. "Results of Breeding Experiments and other Observations on *Cyclops vernalis*, Fischer, and *Cyclops robustus*, G. O. Sars." Internat. Revue der ges. Hydrobiol. u. Hydrographie, 1928, Bd. xxi. Heft 3/4.

XVII.—*Contributions to a Study of the British Species of* Machilidæ.—I. By H. WOMERSLEY, A.L.S., F.E.S.

THE GENUS *PRÆMACHILIS*, SILV.

This genus was defined by Prof. F. Silvestri (6) in 1904 as follows:—

"Coxa pedum secundi et tertii paris processu conico externe instructa, articulo ultimo tarsali apicem versus attenuato.

"Abdominis pars mediana sterni sat longa et sat lata, subcoxæ segmentorum 1–7 utrinque vesicula singula instructæ (in genere *Machilis* s. str. subcoxæ utrinque vesicula duabus).

"♂. Segmenta abdominalia 8 nm. et 9 nm. appendicibus genitalibus duabus subcylindricis, transversaliter anulatis aucta. Penis subcoxarum segmenti ix. marginem posticum nol vel vix superans.

"Species typica *Præmachilis excelsior*, sp. n."

In 1910 Dr. Verhoeff (8), in reviewing the systematics of the Machilidæ, raised them to the rank of a subclass—Machiloidæ—containing the three families Meinertellidæ, Teutonidæ, and Machilidæ. The second was co-extensive

with Silvestri's genus *Præmachilis*, but was further divided by Verhoeff into the two genera *Teutonia* and *Præmachilis*. The latter was again split into the subgenera *Parateutonia* and *Præmachilis*, s. str. The chief reason for separating *Teutonia* from *Præmachilis* was the relative disposition of the paired ocelli, these being in *Præmachilis* submedial, while in *Teutonia* they are lateral or sublateral.

Later, in 1912 (9), Verhoeff sunk the terms Teutonidæ and *Teutonia* in favour of Forbicinidæ and *Forbicina*, Geof., respectively, on the ground that the structure of the ovipositor in his Teutonidæ agreed with Burmeister's description of *Forbicina* in his 'Handbuch der Entom,' ii. Bd. 2, 1838.

Dr. G. H. Carpenter (3) simplified the position by reducing Verhoeff's families to the rank of subfamilies, and used the term Præmachilinæ for Forbicinidæ, recognizing only the three subfamilies Meinertellinæ, Præmachilinæ, and Machilinæ of the family Machilidæ.

In this paper I retain the generic name *Præmachilis* in the older and wider sense, although the species to be described would fall into Verhoeff's genus *Forbicina* (*Teutonia*).

In the British Isles no species of the genus was known until Dr. Carpenter, in 1907, diagnosed *Præmachilis hibernica* from Lambay Island, Co. Dublin, Ireland (2).

Since then the English inland-occurring Machilid, which had previously been known as *Machilis polypoda*, Linn., Lubk. (4), came to be regarded as Carpenter's species. It has been shown, however, by Silvestri (6) that the *M. polypoda* of Linnæus is a true Machilid, and as no species of this genus has been found in this country since Lubbock's work, his solitary specimen was probably a *Præmachilis*.

In the Ent. Month. Mag. for 1880 H. N. Ridley (5) describes under the name *brevicornis* a Machilid from the Radnor Forest. As this name, however, had been previously used by both Lucas and Latreille, it was changed by Bagnall (1) to *parvicornis*, and referred to the genus *Præmachilis*, Silv. Ridley's description is, however, far from satisfactory, and very little more than a comparison with Lubbock's description of his *polypoda*.

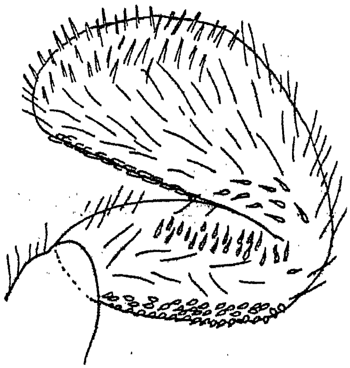
In 1836 R. Templeton (7) figured and described *Forbicina polypoda*, Linn., as a common Irish insect. Again, the drawings are useless, although Lubbock gave Templeton's name as a synonym of *Machilis polypoda*, L. As, however, I show later that at least two species of *Præmachilis* occur in Ireland, it is not certain which Templeton had before him, although as *P. hibernica*, Carp., is the common inland species both in Ireland and England, it was probably this one.

Præmachilis hibernica, Carp. (Fig. 1.)

= *Forbicina polypoda*, Templeton, 1834, nec Linn.
= *Machilis polypoda*, Lubbock, 1873.
= *Machilis brevicornis*, Ridley, 1880.
= *Præmachilis parvicornis*, Bagnall, 1908; nom. nov. for *M. brevicornis*, Ridley.

This species was described and figured by Dr. Carpenter (2) from three specimens from Lambay Island, Co. Dublin, and recorded at the same time from many other parts of Ireland. Through the kindness and help of Mr. A. W. Stelfox, of the National Museum, Dublin, I have been able to study the type-slides of Dr. Carpenter's dissections and to compare them critically with many specimens taken by Mr. Stelfox and Mr. E. O'Mahoney on the South Cliffs, Howth, Co. Dublin, January 13th, 1929, by Mr. Stelfox and myself in the same

Fig. 1.



Male labial palp of *Præmachilis hibernica*, Carp.

locality, April 2nd, 1929, and in the Devil's Glen, Co. Wicklow, March 31st, 1929, and with many specimens from various English localities. As a result, Carpenter's species can be defined with more certainty, and differentiated from the other species which are shown to occur in the British Isles.

In addition to the details given in the original description the following are of importance:—

Antennal flagellum with segments uniformly of three joints in both sexes, but each joint shows one or two subdivision-lines at which secondary jointing may occur, so that care must be exercised in observing these. In the male each joint has a maximum of three subdivisions, or nine to

each segment of the flagellum. In the female the first two joints of a segment appear to have only two subjoints and the third joint three, making seven to each flagellar segment. Comparison of a number of specimens and of other species shows that this character is fairly reliable, if used in conjunction with the following. The second joint of the labial palpi in the male (fig. 1) is strikingly armed on the outer edge with numerous short stumpy setæ, while ventrally and submedially there is also an irregular double row of slightly longer setæ, which extend to the base of the apical joint. In the female the labial palpi are quite unarmed, except for the usual hairs and the apical sensory setæ ("Sinneskegeln" of Verhoeff) on the last joint. These "Sinneskegeln" are present in both sexes, and, although not shown in Carpenter's drawings, are present in his type, but somewhat damaged and difficult to see.

This species at Howth Head occurs apparently rather less commonly than the next species, judging by the relative numbers taken amongst the clumps of Campion on the cliffs, and inland both in Ireland and England in the thick moss on boulders and rock-faces.

Præmachilis saxicola, sp. n. (Fig. 2.)

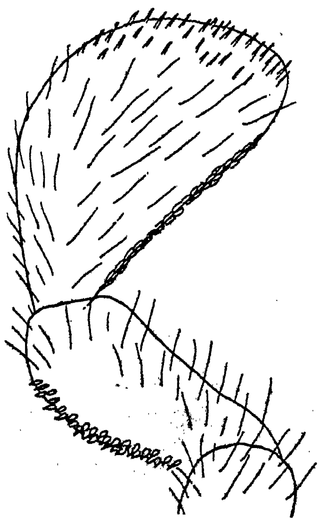
Length 9 mm. Eyes elliptical, about twice as long as broad, with a short median contact. Paired ocelli subquadrate, lateral to eyes. Single ocellus subquadrate. Antennæ about half the length of body, segments of flagellum in both sexes uniformly with four joints, first three joints of each segment only once subdivided, fourth twice, *i.e.*, nine secondary joints in all; the secondary joints in this species are usually more definite than in the preceding species. Maxillary palpi with apical joint subequal to preceding joint in both sexes. Lacinia slightly shorter than galea. Labial palpi (fig. 2) with second joint in male only armed on the outer edge with short stumpy spines. These spines are numerous, as in *hibernica*, but somewhat broader. In female unarmed. Apical joint of labial palpi unarmed except for relatively few "Sinneskegeln." Median cercus two-thirds body-length, lateral cerci two-fifths of median. Ovipositor reaching slightly beyond tips of ninth stylets. Penis reaching tips of posterior pair of gonapophyses, which reach to two-thirds of the length of ninth subcoxæ.

This species is very closely related to *hibernica*, but can be definitely distinguished by the armature of the second joint of the labial palpi in the male sex, as well as by the

longer terminal joint of the maxillary palpi and by the number of joints in the segments of antennal flagellum in both sexes.

It occurs plentifully at Howth Head, Co. Dublin, along with the preceding species, but so far does not appear to be an inland insect. My specimens were taken on the dates given for *hibernica*.

Fig. 2.



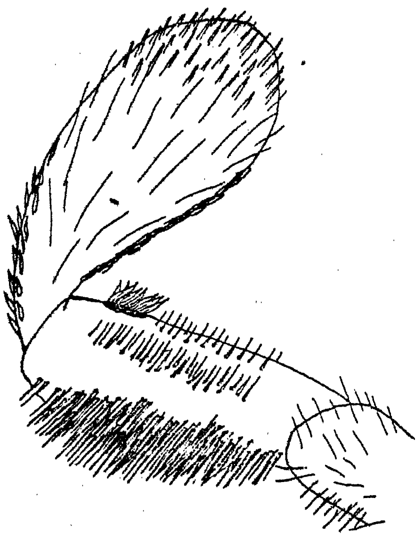
Male labial palp of *Præmachilis saxicola*, sp. n.

Præmachilis littoralis, sp. n. (Fig. 3.)

Length 10 mm. Eyes elliptical, about twice as long as broad, with a short median contact of about half the maximum breadth. Paired ocelli widely separated, rounded, small, *i. e.*, not as broad as the median eye-contact. Single ocellus rather larger than one of the paired ocelli. Antennæ rather more than half body-length, segments five, uniformly with four joints, each joint twice as broad as long, with three or four rows of bristles, and showing little sign of any further subdivision. Maxillary palpi with joints relatively $1\frac{1}{2} : 3 : 2 : 2\frac{1}{2} : 3\frac{1}{2} : 2\frac{1}{2} : 2\frac{1}{2}$; last two joints about equal in both sexes. Lacinia equal to or but slightly less than galea. Labial palpi as in fig. 3, and remarkable for the numerous and varied

sensory spines or setæ on the second joint. This joint is swollen distally, and on the outer half has a very large number of setæ. On the inner shoulder on a slightly raised and pigmented prominence is a cluster of nine long, broad, and flattened setæ. The apical joint has basally on the outer edge a number of broad scale-like setæ, while apically it has an unusually large number of "Sinneskegeln"; this joint is broadest beyond the middle. Median cercus $6\frac{1}{2}$ mm., slightly

Fig. 3.



Male labial palp of *Præmachilis littoralis*, sp. n.

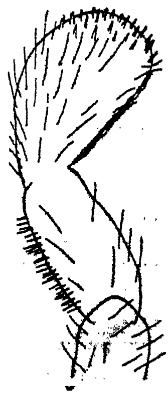
banded distally, lateral cerci two-fifths of the median. Ovipositor extending to about two-fifths of lateral cerci. Penis short, not reaching tips of posterior gonapophyses, which only reach to the middle of the ninth subcoxæ.

This species was first found at Landewednack, Cornwall, where Miss W. Bartlett found a single male amongst the grass at the top of the cliffs, September 1928. I have also examined specimens taken at Alverstone, Isle of Wight, a few years ago by Mr. J. M. Brown; while recently, April 22nd, 1929, Prof. E. B. Poulton and Mr. B. M. Hobby at my request searched for them at St. Helens, I. of W., and were successful in finding a number of specimens. Later, in May 1929, I took a male on Roundham Head, Paignton, Devon.

Præmachilis thornleyi, sp. n. (Fig. 4.)

Length 8–9 mm. Eyes elliptical, about twice as long as broad, with a short median contact. Paired ocelli subrotund, slightly overreaching the lateral edge of the eyes, small, *i.e.*, not as broad of the median contact. Single ocellus subquadrate. Antennæ less than half as long as the body, flagellum with five segments of four joints, but each joint shows so much secondary division that usually there appears to be a gradually increasing number of joints (up to 7 or 8) to each segment. Maxillary palpi in male with joints relatively $1\frac{1}{2}:2:1\frac{1}{2}:1\frac{1}{2}:2\frac{1}{2}:2:2$; in female $1\frac{1}{2}:2:1\frac{1}{2}:1\frac{1}{2}:$

Fig. 4.



Male labial palp of *Præmachilis thornleyi*, sp. n.

$2\frac{1}{2}:2:1\frac{3}{4}$; lacinia shorter than galea. Labial palpi in male as in fig. 4; second joint armed only with numerous slightly curved needle-like spines on outer edge, in female quite unarmed; apical joint only with few "Sinneskegeln" in both sexes. Median cercus about two-thirds of body-length, lateral cerci less than one-third of length of median cercus. Ovipositor reaching a little beyond tip of ninth subcoxæ. Penis reaching to half the length of ninth subcoxæ and beyond tips of posterior pair of gonapophyses.

This species was taken amongst grass-roots etc. on the cliff-edge near Carbis Bay, St. Ives, Cornwall, in October 1928, by the Rev. A. Thornley. It is fairly close to *P. saxicola*, but differs in the form of the spines on the second joint of the labial palpi in the male. Further, it is the only British species which has the penis exceeding the gonapophyses in length.

Summary.

At least four species of *Præmachilis* can be recognized from the British Isles, of which three are new to science.

They can be separated by the armature of the second joint of the labial palpi in the male sex, as in the following table, and to some extent by the jointing of the antennal flagellum in both sexes, although secondary division of the joints occurs and renders this character rather uncertain.

Table for Males of the Britannic Species of Præmachilis, *Silv.*

1. Second joint of labial palpi with a cluster of long broad setæ on the inner shoulder ..	*P. littoralis*, sp. n.
Second joint of labial palpi without the above.	2.
2. Second joint of labial palpi with fine needle-like setæ on outer edge	*P. thornleyi*, sp. n.
Second joint of labial palpi with broad stumpy setæ on outer edge	3.
3. Second joint of labial palpi with an additional series of specialized setæ, ventral and submedial, and extending on to base of apical joint	*P. hibernica*, Carp.
Second joint of labial palpi only with the setæ on the outer edge	*P. saxicola*, sp. n.

References.

(1) Bagnall, R. S. 1908. "The Bristle-tails of the Derwent Valley." Trans. Vale of Derwent Nat. F. C. n. s. vol. i. p, 29.

(2) Carpenter, G. H. 1907. "Aptera," Nat. Hist. of Lambay. Irish Nat. vol. xvi. nos. 1 and 2.

(3) ——. 1916. "The Apterygota of the Seychelles." Proc. Roy. Irish Acad. vol. xxxiii. ser. B, no. 1.

(4) Lubbock, Sir J. 1873. 'Mono. Collembola and Thysanura.' Ray Soc.

(5) Ridley, H. N. 1880. "A new Species of *Machilis*." Ent. Month. Mag. p. 2.

(6) Silvestri, F. 1904. "Nuovi Genere e Specie di Machilidæ." Redia, ii. pp. 1–9.

(7) Templeton, J. 1834. "Thysanuræ Hibernicæ." Proc. Ent. Soc. London, vol. i. p. 89.

(8) Verhoeff, K. W. 1910. "Ueber Felsenspringer Machiloidæ, 4 Aufsatz, Systematik und Orthomorphose." Zool. Anz. xxxvi. pp. 425–438.

(9) ——. 1912. "Ueber Felsenspringer Machiloidæ, 6 Aufsatz, *Halomachilis* und *Forbicina*." Zool. f. wiss. Insektenbiol.

XVIII.—*A new Family of Heteromerous Coleoptera* (Hemipeplidæ), *with Descriptions of a new Genus and a few new Species.* By Gilbert J. Arrow.

Near allies of the curious genus *Hemipeplus* have hitherto been unknown, and its systematic position has long been a matter of doubt. Lacordaire associated it with the genus *Ino* in a tribe of Cucujidæ which he called Hemipeplides and characterized chiefly by the possession of very short elytra. This feature unfortunately was due to an accident to the only specimen then known, and the two genera really differ very greatly. Casey expressed the opinion that *Hemipeplus* should form a family of Heteromera near the Œdemeridæ. The tarsi are heteromerous, a condition not unusual in the males of Cucujidæ and found in both sexes of a few genera which appear to have the closest affinity with Cryptophagidæ. With the latter *Hemipeplus* has no apparent relationship, and with the Cucujidæ proper there seems to be little. The Cucujidæ have usually widely separated coxæ, with open front coxal cavities, and, except in the subfamily Silvaninæ, which differ in almost all respects from our insects, are distinguished by their long filiform antennæ and simple tarsi, the latter generally with the basal joint short. All these features are foreign to *Hemipeplus* and the new genus here described. This genus, although superficially unlike *Hemipeplus*, is undoubtedly a near ally of it and has all its more important features. These are the lobed heteromerous tarsi, the nearly contiguous front and middle coxæ (the former completely enclosed and placed far from the hind edge of the prothorax), the long free ventral sternites, of which the basal one is articulated with the metasternum by a very long and narrow median process.

Hemipeplus was admitted into the Cucujidæ upon the assumption that it would prove, like other members of the family, to be heteromerous in the male sex only; but, in the light of our fuller knowledge of it, it seems impossible to include it in that or any other known family, and I therefore propose to form for the two genera a new family (Hemipeplidæ), which it seems most convenient, in view of the tarsal structure, to attach to the Heteromera. Various genera which have already been placed both in Heteromera and Cucujidæ or their neighbourhood (*Hymæa*, *Othnius*, etc.) show the difficulty of fixing the boundary between the two groups and the probably close relationship between them. The Hemipeplidæ appear to show some affinity with the Pythidæ, and perhaps still more with the Lagriidæ, the

structure of the head being similar to that of the former, while the sternum and coxæ are almost as in the latter.

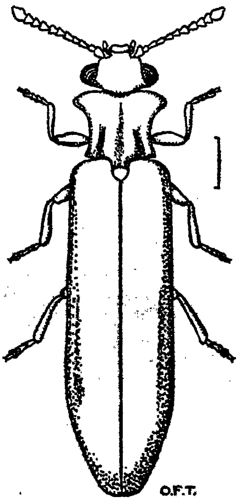
The genus *Hemipeplus* was first described by Latreille in 1825 from a specimen found in a Scottish shop, and sent to him by Dr. Leach of the British Museum. The specimen was apparently introduced by accident from abroad, and, according to C. O. Waterhouse, who saw it in Janson's collection in 1876, was in damaged condition, the shortness of the elytra, which led Latreille to call it *Hemipeplus*, being accidental. Latreille gave it no specific name, but the catalogue name *Nemicelus hemipterus* was given to it by Dejean, who had probably acquired, or at any rate seen, the original specimen. This is said to have passed into the possession of Reiche, and later that of E. W. Janson, whose collection has since been dispersed. Dejean added a second species from N. America, which he called *marginipennis*; but these names, being unaccompanied by descriptions, have no validity. In 1854 a species, *Hemipeplus marginipennis*, was described by Leconte, and in 1866 Pascoe described a West-Indian insect, belonging to the same genus, as *Ochrosanis dohrni*. Leconte later suggested that this species might be the same as *H. marginipennis*, but Waterhouse, in 1876, refused to accept this, believing *dohrni* to be identical with the undescribed *H. hemipterus*. In 1878 E. A. Schwartz added yet another N.-American species, which he called *Nemicelus microphthalmus*.

In 1880 Dr. G. H. Horn reviewed the history of the genus, and came to the conclusion that all the various names quoted above belonged to a single variable species. Since that date Grouvelle has described a number of species from Central and South America, E. and W. Africa, and Madagascar, in addition to which a Bornean form had been recorded in 1873 by Dr. Gestro as *Ochrosanis klematanica*. The greater knowledge of the insects now acquired shows that they are not very variable, as supposed by Horn, nor are the two sexes markedly different, as he believed. In my opinion, although the three generic names are synonymous, there is no sufficient reason for regarding any of the specific names as redundant. To which of the species the still undescribed *Hemipeplus hemipterus* belongs it is not possible to decide in the absence of the original specimen.

Including the three new species here described sixteen members of the genus have been distinguished. These show it to be remarkable alike for the constancy of its general form and the wide extent of its distribution, its range being now found to extend to Celebes and North Australia.

So far as at present known, these insects feed upon the leaves of palms. *Hemipeplus nuciferæ* is found attacking the young unfolded leaves of the coconut-palm, and *H. marginipennis* lives, according to Horn, on *Chamærops palmetto*. The various species differ chiefly in the size of the eyes, the shape of the thorax and of the tips of the elytra. The persistence throughout nearly all the forms of a, generally rather faint, brown mark common to the two elytra a little before the tips is remarkable. It was no doubt the persistence of usually variable features which led Horn to declare all the forms described by his predecessors to belong to a single species.

Fig. 1.



Hemipeplus egregius, Arrow. × 10.

Hemipeplus egregius, sp. n. (Fig. 1.)

Ferrugineus, opacus, elytrorum postice lateribus lineaque suturali haud brevi infuscatis; elongatus, minute sat dense griseo-pubescens, capite latissimo, oculis permagnis, antennis sat brevibus, articulis 6–10 transversis; pronoto antice latissimo, angulis omnibus sat acutis, lateribus concavis, basi medio fortiter producto, lobo truncato, postice excavato, disco postice utrinque profunde longitudinaliter foveato, scutello fere semicirculari; elytris minute et crebre punctatis, lateribus antice parallelis, postice attenuatis, apice conjunctim rotundatis, abdomine toto tecto.

Long. 7·3 mm.; lat. max. 2 mm.

E. Africa, Tanganyika Terr.: Kilindi (*A. Loveridge*, April).

Only a single example is known, representing perhaps the most strongly differentiated of the known species of *Hemipeplus*. It is rusty red in colour, opaque, and clothed with close and fine pubescence. The eyes are large and extremely prominent, their width, as seen from above, being not much less than their length, and the distance apart in the middle is equal to the total length of the head. The pronotum is distinctly wider than it is long, very strongly dilated anteriorly, the front margin slightly excised in the middle but not reflexed, the lateral margins strongly concave, the base a little dilated, rendering the hind angles rather sharp, and produced in the middle into a strong truncate lobe, which is carinate on each side and hollowed between the carinæ. There is a long and deep longitudinal fovea on each side, extending from near the middle almost to the base. The scutellum is almost semicircular, with its base depressed and covered by the prothoracic lobe. The elytra are finely and densely punctured, the sides rather abruptly vertical but not carinate above, tapering in the posterior third and conjointly rounded and not truncate at the end, the abdomen being entirely covered. The elytra are rather less elongate than in most of the species, and the head and prothorax measure a little more than a quarter of the total length. The antennæ are shorter than the head and prothorax together; the first, third, fifth and eleventh joints are slightly elongate, the fourth almost as wide as it is long, and the rest distinctly transverse.

Hemipeplus australicus, sp. n.

Flavo-rufus, elytris pallide flavis, macula subrotundata rufa subapicali; elongatissimus, ubique dense punctatus et minute setosus, capite brevi, oculis sat magnis, antennis brevibus; pronoto transverso, margine antico reflexo, vix sinuato, lateribus antice valde rotundatis, postice contractis, angulis posticis fere rectis, basi leviter rotundato, haud lobato, disco postice utrinque fovea punctiformi minuta impresso, scutello transverse subovali; elytris subnitidis, longissimis, antice parallelis, postice attenuatis, apicibus haud truncatis, abdomine toto tecto.

Long. 3·5–4 mm.; lat. max. ·75 mm.

North Australia: Port Darwin, Adelaide River.

Several examples were taken by Commander J. J. Walker in August 1890. The colour is very pale, the elytra are

feebly shining, and the upper surface is entirely clothed with minute pale setæ. The eyes are large and prominent, and the upper surface of the head, exclusive of the eyes and clypeus, is distinctly wider than long. The pronotum is transverse, with its front margin distinctly thickened, reflexed and ciliate above, but only very feebly excised. The sides are strongly dilated and rounded anteriorly and much contracted behind, and the hind angles are distinct but not sharp. The elytra are extremely pale in colour, tapering behind, rounded at the sides, and almost conceal the abdomen.

This is much paler in colour than *H. klematanica*, Gestro, with longer legs but shorter antennæ, the latter being not quite as long as the head and pronotum together. The head is less prominent behind the eye and the prothorax is more strongly narrowed in its posterior half.

Hemipeplus nuciferæ, sp. n.

Ferrugineus, opacus, elytrorum macula rufa, subrotundata, subapicali; elongatissimus, ubique dense punctatus et minute setosus, oculis magnis, antennis brevibus, clava sat lata; pronoto longitudine paulo latiori, margine antico leviter reflexo, vix sinuato, lateribus antice valde rotundatis, postice contractis, angulis posticis obtusis, basi leviter rotundato, haud lobato, disco postice utrinque fovea punctiformi minuta impresso, scutello transverse ovali; elytris longissimis, antice parallelis, postice attenuatis, apicibus conjunctim rotundatis, abdomine fere toto tecto.

Long. 3·5 mm.; lat. max. ·75 mm.

CELEBES: Sangi.

Several specimens were taken by Mr. A. Reyne upon young unexpanded coconut-leaves, upon which they were feeding.

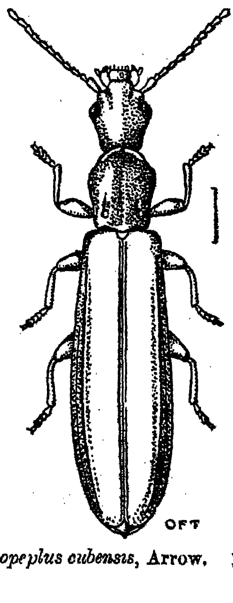
The species has a close resemblance to *H. australicus* and is of similar small size. It is rather more opaque and closely punctured, the elytra not being shining as in *H. australicus*. The eyes are of similar size, but a trifle less prominent, the upper surface of the head, exclusive of the eyes and clypeus, is as long as it is wide, and not transverse as in the Australian species, and the antennæ are wider, joints 6–10 being distinctly transverse.

It is even more nearly related to the Bornean *H. klematanica*, Gestro, which, however, has longer and slenderer antennæ and sharper hind angles to the prothorax.

HOLOPEPLUS, gen. nov.

Corpus modice elongatum, depressum. Pedes breves, tarsi 5-, 5-, 4-articulati. Caput porrectum, postice elongatum, vertice abrupte declivo, oculis haud prominentibus, sat parvis, a thorace remotis, antennis filiformibus, articulo basali magno, elongato. Clypeus transverse rectangulus, haud latus. Labrum et mandibulæ exsertæ. Pronotum angustum, antice late lobatum, margine antico incrassato, reflexo, setoso. Acetabulæ prosternales fere contiguæ, postice occlusæ. Pedum intermediorum coxæ fere contiguæ. Metasternum postice medio anguste incisum. Abdominis segmentum ventrale primum medio anguste productum, segmentum dorsale ultimum postice dentatum.

Fig. 2.



Holopeplus cubensis, Arrow. × 10.

Holopeplus cubensis, sp. n. (Fig. 2.)

Fusco-brunneus, antennis pedibusque rufescentibus; angustus, capite pronotoque subopacis, elongatis, illo dense granuloso-rugoso, antice læviori, oculis haud magnis aut prominentibus, parte postoculari longe producto, retrorsum attenuato, ante pronoti marginem abrupte retuso; pronoto lateraliter dense granuloso, dorso fortiter punctato, medio canaliculato et utrinque prope angulos basales longe sat profunde foveato, margine antico rotundato-lobato, medio interrupto, utrinque incrassato, setoso, lateribus antice rotundatis, retrorsum paulo contractis, postice

fere parallelis, angulis anticis nullis, posticis obtuse rectis, basi trisinuato, medio late lobato, scutello lato, rugoso; elytris subnitidis, leviter transversim rugulosis, haud striatis, quam prothoracem multo latioribus, pone medium paulo dilatatis, postice attenuatis, apicibus separatim rotundatis, lateribus verticalibus, supra acute carinatis; abdominis apice vix tecto, acuminato; antennis quam capitem et prothoracem conjunctim paulo brevioribus, articulo secundo vix elongato, reliquis multo elongatis, primo crasso, ultimo acuminato: pygidii apice, ♂ acute, ♀ obtuse dentato.

Long. 7·5 mm.; lat. max. 2 mm.

CUBA; Holquin.

A male specimen and a fragment of a female, from the late D. Sharp's collection, were found in 1904, but no further information is recorded.

In spite of its different aspect, *Holopeplus* agrees with *Hemipeplus* in all its essential features. The elongation of the head and thorax renders the length of the elytra and hind body much less disproportionate, but the structure of the sterna, tarsi, the antennæ, and the mouth-organs, the peculiar thickened and reflexed front margin of the pronotum, the deep basal foveæ, the abruptly vertical sides of the elytra, are all as in the other genus. The most important differences are found in the more convex head and thorax of *Holopeplus*, the great elongation of the head, its peculiar vertical declivity behind preventing its retraction within the thorax, the produced anterior part of the pronotum, and the angulation of the last tergite of the abdomen, which in the male is produced into a pointed lobe.

XIX.—*A Comparative Study of the Otoliths of the Neopterygian Fishes* (continued). By G. ALLAN FROST.

[Plate IX.]

XX. Order HETEROSOMATA.

The fishes of the order Heterosomata have been shown by Dr. Tate Regan to be derived from a Percoid stem *, and this origin of the group is further supported by a study of the otoliths.

* Ann. & Mag. Nat. Hist. ser. 8, vol. vi. p. 484 (1910).

Suborder PSETTODOIDEA.

The otolith of *Psettodes erumei* (Pl. IX. fig. 1), of the family Psettodidæ, resembles in every feature those of the suborder Percoidea, the only modification being the presence of a slight crest on the anterior rim in front of the sulcus. The shape resembles that of *Perca* and the sulcus reproduces that of *Centropomus*, both of the suborder Percoidea ; the sulcus has an upper and a lower angle, and a curved and pointed cauda. It differs in the presence of a narrow crest which encloses the front of the ostium, and in the dentations of the ventral rim. Except for these slight modifications, it is essentially the otolith of a Percoid Fish. It is rather more curved in its length than those of the remainder of the Flat-fishes.

Suborder PLEURONECTOIDEA.

Family Pleuronectidæ.

In *Hippoglossus hippoglossus* (Pl. IX. fig. 2), the sagitta resembles that of *Psettodes* in the anterior rim and præsulcal crest, and in the presence of an upper and a lower angle to the sulcus. It differs in the flatter sides, in the straight dorsal rim, in the obliquity of the anterior part of the ventral rim and upright posterior rim, in the reversed proportions of the sulcus, in which the ostium is longer than the cauda, in the cauda itself, which is shortened and ovate, and in the presence of a groove below the sulcus. In aged examples the shape of the otolith may become pentangular, and the otolith of the left side then exceeds that of the right in height.

The otoliths from an example of *Reinhardtius hippoglossoides* (the Greenland Halibut), kindly sent me by Prof. Johs. Schmidt, differ so completely from each other and are so fantastically malformed as to be useless for comparative purposes, and are therefore not figured.

The sagitta of *Hippoglossoides limandoides* (Pl. IX. fig. 3) resembles that of *Hippoglossus* in shape. It differs in the presence of a wide præsulcal area, in the ovate and shorter ostium, and in the absence of an upper angle to the sulcus ; also in the posterior rim, the upper part of which is concave, forming an upper and a lower angle.

In *Atheresthes stomias* (Pl. IX. fig. 4) the sagitta resembles that of *Hippoglossus* in the oblique anterior part of the ventral rim and in the general formation of the

sulcus. It differs in the narrow front of the otolith, in the wide præsulcal area, in the domed dorsal rim, and in the deeply indented posterior rim.

In *Kareius bicoloratus* (Pl. IX. fig. 5) the otolith resembles that of *Hippoglossus* in the flat straight sides, in the shape of the anterior and ventral rims, and in the long narrow sulcus; it differs in the irregular dorsal rim, the slightly concave posterior rim, and the serrations of the edges.

The otoliths of the majority of the remaining species of the family Pleuronectidæ present a distinct type which may be described as "Pleuronectid," of which that of *P. flesus* may be taken as representative. The form is evidently derived from the more Percid type represented in the otoliths of *Hippoglossus*, and resembles closely that of *Hippoglossoides*.

In *Pleuronectes flesus* (Pl. IX. fig. 6) the sagitta is straight and ovate in outline. The outer side is flat and the inner side is raised round the sulcus, below which a groove extends to behind the cauda. The dorsal rim is straight, the ventral rim is symmetrically curved and serrated; the posterior rim is concave and forms an acute angle, with the dorsal rim and another sharply defined angle with the ventral rim; the anterior rim contains a rounded rostrum, above which it recedes and passes into the dorsal rim; a wide præsulcal area is present. The sulcus is Biovate and entirely enclosed; the ostium is longer and wider than the cauda, and both have rounded ends, that of the cauda being well removed from the posterior rim. An upper and a lower angle are present in the sulcus.

In the otolith of a young example of *Pleuronectes platessa* (Pl. IX. fig. 7) the otolith is of the foregoing Pleuronectid type; it differs in the slightly irregular dorsal rim, the smaller rostrum, the rounded posterior rim in which the upper angle is obtuse and a lower angle is absent, and the smooth ventral rim. In mature examples the posterior rim is perpendicular or slightly concave, and the upper angle is rectangular. In aged examples the anterior rim is rounded and without a rostrum, and the posterior angle may be produced, in which case the hinder part of the usually flat outer side is more or less fluted in line with the extended upper angle.

In *Pleuronectes limanda* (Pl. IX. fig. 8) the sagitta resembles that of *Hippoglossus*. It differs in the presence of a postero-dorsal angle and in the slight concavity of the upper part of the posterior rim; also in the symmetrical

ventral rim, and the shallowing front of the ostium, which disappears, leaving a broad præsulcal area as *P. flesus*.

In *Microstomus microcephalus* (Pl. IX. fig. 9) the otolith is thick, and the outer side is convex. In the example described the shape is sub-circular, the dorsal rim is high, the posterior rim is slightly rounded and forms an angle with the curved ventral rim, and the anterior rim contains a blunt rostrum, a small pointed antirostrum, and an excisura. The sulcus opens on the anterior rim and the cauda is pointed, both features occurring in the otoliths of the family Bothidæ described below; a median constriction is present, but there are no definite angles. Ostium and cauda are equal.

The otolith of *Glyptocephalus cynoglossus* (Pl. IX. fig. 10) is aberrant in form, but the example figured shows a resemblance to those of the remainder of the family Pleuronectidæ in the dorsal and posterior rims and in the angle between them. The shape is variable, but is usually nearly circular; an unusual feature is the thickness of the otolith and the strong convexity of the outer side, the inner side being flat. In some examples the postero-dorsal angle is absent, and an angle is present between the ventral and posterior rims. In the example figured the shape is circular, the outline being disturbed only by the upper posterior angle and by dentations of the anterior rim in front of the sulcus. The sulcus occupies a median position, has raised edges, and is surrounded except in front by a groove. The ostium is wide and shallow and the anterior border is undefined; the cauda is wide with rounded end and terminates near the middle of the otolith.

The sagitta of *Paralichthodes algoensis* (Pl. IX. fig. 11) resembles that of *Pleuronectes flesus*. It differs in the pointed rostrum, and in the posterior rim, which is very slightly concave and is without an upper or lower angle. In the example figured the frontal limit of the sulcus and its angles, if any, are not clearly indicated.

In *Peltorhamphus novæ zeelandiæ* (Pl. IX. fig. 12) the otolith is unlike that of any other member of the family Pleuronectidæ. The shape is pentangular, the outer side being concave and the inner side strongly convex. The dorsal rim is high, the posterior rim oblique; the ventral rim is irregular and deepest anteriorly, and the anterior rim is small and rounded, containing a slight pointed rostrum. The sulcus opens on the anterior rim; the ostium is narrow and straight, and the cauda is indicated by a fine circular line, the interior being flush with the surrounding surface of the otolith.

Family Bothidæ.

The sagitta of *Citharus linguatula* (Pl. IX. fig. 13) exhibits at first sight a marked resemblance to those of the suborder Percoidea. It resembles in shape, height, and general form those of the family Sparidæ, and the sulcus is similar to those of the Serranidæ and allied forms. The shape is ovate, symmetrical, and slightly biconvex. A feature distinguishing it from the Percid otoliths is a thickening of the posterior part. The dorsal, posterior, and ventral rims all have a median angle; the anterior rim is oblique above, and curved below the sulcus; a rostrum and a small antirostrum are present. The sulcus is horizontal, has slight upper and lower angles, and opens on the anterior rim. The ostium is wider and shorter than the long narrow cauda, the end of which is slightly inclined downwards, and does not approach the posterior rim. The ventral area of the inner side has a wide shallow depression below the sulcus.

In *Arnoglossus grohmanni* (Pl. IX. fig. 14) the sagitta resembles the Pleuronectid type, but the sulcus opens on the anterior rim. The shape is oblong; the dorsal rim is domed, the posterior rim is upright and indented, and the ventral rim is oblique anteriorly, as in the otoliths of the family Soleidæ, and in a lesser degree in those of *Hippoglossus* and *Hippoglossoides.* The sulcus is wide and horizontal, opens on the anterior rim, and is surrounded by a groove; the ostium is depressed and the upper margin waved; the cauda is shorter than the ostium, and the rounded end is well removed from the posterior rim.

In *Bothus podas* (Pl. IX. fig. 15) the otolith is leaf-shaped, with the anterior end the larger. Both the anterior and the small posterior rim are flattened, and the dorsal and ventral rims are curved. The sulcus is enclosed and a præsulcal area is present; the ostium is longer than the small pointed cauda, which has a straight lower line and ends near the centre of the otolith.

In *Lepidorhombus megastoma* (Pl. IX. fig. 16) the shape of the sagitta is irregular and elongate; the dorsal rim is dentated and has an anterior upward projection; the ventral rim is curved and forms an angle with the oblique posterior rim, of which the upper part is produced, while below this is a slit-like aperture; the anterior rim consists of a well-defined rostrum and a small antirostrum. The sulcus resembles that of *Bothus* and has a præsulcal crest, but differs in the shape of the lower angle. The lower line of the cauda is straight and the pointed end is well removed from the posterior rim.

In *Rhombus lævis* (Pl. IX. fig. 17) the sagitta is of the Percid type and resembles that of *Psettodes* in the oblique anterior rim, in the dorsal and ventral rims, and in the projection of the lower part of the posterior rim. It differs in the rounded rostrum and in the presence of a minute antirostrum. The sulcus opens on the anterior rim and otherwise resembles that of *Lepidorhombus*.

In *Rhombus maximus* (Pl. IX. fig. 18) the otolith resembles that of *R. lævis* in the oblique anterior rim, and in the sulcus which opens on it. It differs in the strong curvature of the otolith, in the height of the dorsal rim, and in the depth and irregularity of the ventral rim; also in the perpendicular and serrated posterior rim, and in the curved lower line of the pointed cauda.

Suborder SOLEOIDEA.

Family Soleidæ.

In the family Soleidæ the otoliths resemble those of the family Pleuronectidæ sufficiently to show the relationship, but are distinctly shortened, and in some cases contorted. The degree of variability of the otoliths in different examples of the same species is somewhat higher than usual.

In *Solea vulgaris* (Pl. IX. fig. 19) the sagitta (in the example figured) resembles that of *Pleuronectes flesus* in the dorsal rim, curved posterior rim, and upper posterior angle; a lower angle is also present, but is more obtuse than in *P. flesus*. It differs in the greater curvature of the otolith, the increased convexity of the inner side, the shortened front part of the otolith, the absence of a rostrum, and in the greater obliquity of the anterior part of the ventral rim. It also differs in the form of the sulcus, in which the ostium is narrow and in front is pointed and upturned, and the cauda is small, ovate, and deep; an upper and a lower angle are present in the sulcus. The centre of the inner side is raised, and a deep vallum surrounds the sulcus except on the anterior rim. In large examples the posterior rim is more concave, and has a more acute lower angle.

In *Solea lascaris* (Pl. IX. fig. 20) the sagitta resembles that of *S. vulgaris* in the concave posterior rim, which, however, differs in the backward inclination of the lower part, and in a consequent modification of the upper and lower angles. It also resembles *S. vulgaris* exactly in the ostium; in the presence of an upper and a lower angle to the sulcus, and in the surrounding groove. It differs in the

indented anterior rim, the deeper ventral rim, which is more acutely oblique anteriorly, and straight posteriorly, and in the round and larger cauda.

In *Solea ocellata* (Pl. IX. fig. 21) the otolith resembles that of *S. vulgaris* in the dorsal rim, the obliquely-fronted ventral rim, and in the groove surrounding the sulcus. It differs in the flatter slightly convex outer and inner sides, the convex posterior rim, which is without an upper or lower angle, and the pointed anterior rim; also in the broader ostium and large ovate cauda. The sulcus is constricted medianly, but no definite angles are present.

The otoliths of *Solea variegata* (Pl. IX. fig. 22) show a high degree of variation, the outline in some cases forming nearly a perfect circle, while others are ovate or as in the example figured. This resembles the sagitta of *S. vulgaris* in the dorsal, ventral, and anterior rims, the flat outer side, and the convexity of the inner side, a typical feature being the obliquity of the anterior part of the ventral rim. It also resembles it in the enclosed biovate sulcus, in which, however, the angles are less distinct, and the cauda is more ovate. It differs in the absence of a groove round the sulcus, and in a flattening of the rims in the more circular examples.

In *Solea kleinii* (Pl. IX. fig. 23) a different form occurs, the otolith being flat on both sides, and the shape conforming more to the Pleuronectid type than in the previously described species of the Sole family. The dorsal, ventral, and posterior rims resemble those of *Pleuronectes flesus*; it differs in the truncated concave anterior rim and in the sulcus, which resembles that of *Glyptocephalus*. A groove closely surrounds the sulcus, except on the anterior rim, which is depressed.

Family **Cynoglossidæ**.

The sagitta of *Cynoglossus semilævis* (Pl. IX. fig. 24) resembles that of *Peltorhamphus* of the suborder Pleuronectoidea. Features in common are:—the longitudinal curvature of the otolith, the small pointed rostrum, rounded antirostrum, small excisura, the opening of the sulcus on the anterior rim, and the round and distended cauda. It differs in the regular dorsal rim, the concave posterior rim, in which it resembles *Solea lascaris*, and in the ventral rim which is the same as in *Solea vulgaris*. It also differs in the deeply evcavated and undivided sulcus, which widens out from the opening on the anterior rim, and is without the median constriction present in the otolith of *Peltorhamphus*.

SUMMARY.

1. It is apparent from a comparison of the otoliths that the fishes of the order Heterosomata are derived from a Percoid stem. Outstanding Percid forms are seen in the otoliths of *Psettodes* and *Citharus*, while those of *Hippoglossus* and of the members of the family Bothidæ may be described as sub-Percid.

2. The otoliths of the family Pleuronectidæ are more specialized and give rise to the Pleuronectid type. This may be distinguished by the following features:—Shape ovate and straight, with rounded rostrum, no antirostrum or excisura; outer side flat, inner side slightly convex, raised in centre, and with a wide præsulcal area. Posterior rim with upper angle, below which it is concave, except in young examples, a lower angle occurring in some species. Sulcus enclosed, biovate, with upper and lower angles; ostium longer and broader than cauda, which has a rounded end, and does not approach the posterior rim.

E. g., *Pleuronectes flesus*. An aberrant form occurs in the otolith of *Peltorhamphus*; this is much curved, has a pointed rostrum with small excisura, the ostium opens on the anterior rim, and the cauda is dilated. Other aberrant forms are those of *Microstomus* and *Glyptocephalus*.

3. The otoliths of the family Bothidæ resemble the Percid type especially in *Citharus* and *Rhombus lævis*. The shape is ovate, stouter and less flat than in those of the Pleuronectidæ. The sulcus is long and straight, and in most cases opens on the anterior rim; the ostium is narrow and longer than the cauda, the end of which is pointed and slightly depressed. In *Arnoglossus* the anterior part of the ventral rim is oblique as in *Hippoglossus*.

4. The otoliths of the family Soleidæ resemble the Pleuronectid type, but appear shortened and in some cases contorted; they also differ in thickness, in the greater convexity of the inner side, and in the vallum surrounding the sulcus. A feature is the obliquity of the anterior part of the ventral rim, except in *Solea kleinii* in which the anterior rim is concave and the ventral rim symmetrical. In *Cynoglossus* (family Cynoglossidæ) the sagitta resembles that of *Peltorhamphus* in the presence of a small rostrum and excisura, in the dilated cauda, and in the opening of the ostium on the anterior rim. It differs in the deep excavation of the sulcus and in the concave posterior rim.

I wish to acknowledge with many thanks the use of material kindly supplied by the British Museum (Nat. Hist.),

South Kensington, and the help I have received from Mr. J. R. Norman in the preparation of the foregoing paper.

EXPLANATION OF PLATE IX.

Fig. 1. *Psettodes erumei*, × 2.
Fig. 2. *Hippoglossus hippoglossus*, × 2.
Fig. 3. *Hippoglossoides limanoides*, × 3.
Fig. 4. *Atheresthes stomias*, × 2.
Fig. 5. *Kareius bicoloratus*, × 3.
Fig. 6. *Pleuronectes flesus*, × 3.
Fig. 7. *Pleuronectes platessa*, × 3.
Fig. 8. *Pleuronectes limanda*, × 3.
Fig. 9. *Microstomus microcephalus*, × 3.
Fig. 10. *Glyptocephalus cynoglossus*, × 2.
Fig. 11. *Paralichthodes algoensis*, × 3.
Fig. 12. *Peltorhamphus novæ zeelandiæ*, × 2.
Fig. 13. *Citharus linguatula*, × 3.
Fig. 14. *Arnoglossus grohmanni*, × 5.
Fig. 15. *Bothus podas*, × 6.
Fig. 16. *Lepidorhombus megastoma*, × 1$\frac{3}{4}$.
Fig. 17. *Rhombus lævis*, × 2$\frac{1}{4}$.
Fig. 18. *Rhombus maximus*, × 2.
Fig. 19. *Solea vulgaris*, × 2$\frac{1}{2}$.
Fig. 20. *Solea lascaris*, × 2$\frac{1}{2}$.
Fig. 21. *Solea ocellata*, × 3.
Fig. 22. *Solea variegata*, × 3.
Fig. 23. *Solea kleinii*, × 4.
Fig. 24. *Cynoglossus semilævis*, × 1$\frac{1}{2}$.

XX.—*Notes on the Cephalopoda.*—No. 10. *On* Octopus patagonicus, *Lönnberg.* By G. C. Robson, M.A.

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Through the kindness of Dr. N. Odhner I have been enabled to examine the type-specimen (a female) of *Octopus patagonicus*, Lönnberg, deposited in the State Museum (Zoology), Stockholm. As we know so little about the subgeneric position and specific identity of the Magellanic Octopods it is desirable to publish the results of this examination, which include a description of important features which Lönnberg did not examine.

The size, various proportions, sculpture, and miscellaneous features described in Lönnberg's original diagnosis (1899, p. 50) are substantially correct, or, at least, it is not desirable to vary his account in such unimportant differences as I have noticed, owing to the length of time the specimen has been exposed to the action of preservatives.

The funnel-organ is widely W-shaped like that of the S.W. African *Octopus schultzei*, Hoyle. The suckers are very large (17 per cent. of the mantle-length) on all the arms between the eighth to twelfth pairs, though the enlargement is not discontinuous. The web has the first three sectors subequal, the fourth is somewhat shallower, and the fifth is entirely absent (formula, A=B=C.D). The absence of sector E may be pathological. The web is about 20 per cent. of the arms. The distal part of the oviduct is very long (125 mm.), longer in fact than the dorsal mantle-length, and it appears to be constricted in the middle, as I have already noted in *Octopus ægina* (Robson, 1928, p. 645), into a vagina and oviduct proper. The proximal oviduct is short (35 mm.). The oviducal gland is clearly differentiated into two parts—a larger, distal, darkly pigmented part and a light proximal part. This clearly indicates the subdivision into receptacular and glandular regions discussed by me in a contemporary publication (Robson, 1929, p. 17).

Octopus patagonicus in its arm and web-length, the size of the suckers, female system, the form of the funnel-organ, and in other respects is very like *Enteroctopus megalocyathus.* It is, of course, broader in the body than Gould's form of that species. As, however, I have already pointed out (*l. c.* p. 178), this species seems to be dimorphic in respect of shape, and Lönnberg's species seems to me to be referable to the broad-bodied form of *Enteroctopus megalocyathus*, to which I have also referred Hoyle's *Polypus brucei*. I think, therefore, that Lönnberg's "*patagonicus*" must be relegated to the synonymy of *Enteroctopus megalocyathus*. Examination of Lönnberg's type confirms my impression that *E. eureka*, Robson, and *E. megalocyathus* are distinct species. The funnel-organ is normally W-shaped in *E. eureka*, while in *megalocyathus* (types of "*patagonicus*" and "*brucei*," one Brit. Mus. specimen) it is wide and flat. Another feature in which these forms differ is the female system. In *E. megalocyathus* the distal oviduct is over 3·5 times longer than the proximal part; in the female specimen of *E. eureka* which I have seen it is 2·5 times as long, and, in addition, it is not subdivided as in *E. megalocyathus*.

Bibliography.

Lönnberg, E. 1899. Wiss. Ergebn. Schwed. Exped. Magellansländern.—II. Zoologie, p. 49.

Robson, G. C. 1928. Ann. & Mag. Nat. Hist. (10) i. p. 641.

—— 1929. 'A Monograph of the Recent Cephalopoda.—Part I.' British Museum, London.

XXI.—*Description d'un nouvel* Aseraggodes [*Pisces*, Soleidæ] *du Queensland*. Par Paul Chabanaud.

Avant eu l'occasion d'examiner récemment, à Berlin, le type d'*Aseraggodes melanosticta*, Peters, j'ai constaté l'existence de certains caractères morphologiques, insoupçonnables pour qui n'a pas eu ce spécimen sous les yeux et incompatibles avec la morphologie de l'exemplaire du Queensland, qui figure sous ce nom dans la collection du British Museum, où je l'avais précédemment étudié. Cet exemplaire appartient à une espèce inédite, dont la description se trouve dans les lignes qui suivent et que je me fais un grand plaisir de dédier, en témoignage d'amitié, à M. J. R. Norman, assistant au British Museum.

Aseraggodes normani, sp. n.

Aseraggodes melanostictus, Norman, Biol. Results 'Endeavour,' vol. v. part 5, 1926, p. 290, fig. 12.

Type. Côte du Queensland ; British Museum (collection 'Endeavour,' no. 2860). Longueur totale : 135 millimètres.

D. 68. A. 51. C. 18. Pectorales 0. Pelviennes (chacune) 5. Ecailles (série longitudinale) 72.

°/₀ de la longueur du corps : hauteur 45 ; tête 24.—°/₀ de la longueur de la tête : œil 16·6 ; espace postoculaire 50 ; caudale 100.—°/₀ du diamètre de l'un des yeux : espace interoculaire 25 ; espace oculo-dorsal 133.

Face oculée.—Profil antérieur largement arrondi. Museau non saillant. Bord supérieur de l'œil dorsal au niveau de la ligne latérale (axe du corps). Bord antérieur de l'œil ventral à peine en arrière de l'aplomb du bord antérieur de l'œil dorsal. Tube nasal antérieur inséré en avant de l'aplomb du bord antérieur de l'œil dorsal, presque à égale distance du bord antérieur du museau et de l'œil ventral ; le tube gros, beaucoup plus court que la distance qui sépare sa base de l'œil ventral. Narine postérieure en forme de fente longitudinale, s'ouvrant dans le sillon labial. Lèvre inférieure formant, en son milieu, un angle très saillant, obtusément arrondi ; commissure buccale placée à peine en arrière de l'aplomb du bord antérieur de l'œil ventral. Dorsale : premier rayon inséré au niveau du bord supérieur de l'œil ventral ; les 8 rayons postérieurs progressivement raccourcis ; le dernier inséré très près de la base de la caudale et dépourvu de tout vestige de membrane postérieure. Anale symétrique aux parties surplombantes de la dorsale. Caudale subrhomboïdalement arrondie. Pelvienne droite à

base longue, longitudinale ; son premier rayon inséré très peu en arrière de l'aplomb du bord postérieur de l'œil ventral, sur le plan sagittal médian ; son rayon postérieur relié, par sa membrane à la base de la papille urinaire. Pelvienne gauche parallèle à la pelvienne droite ; son premier rayon symétrique au deuxième de celle-ci ; la membrane de son rayon postérieur très haute et soudée à la membrane du dernier rayon de la pelvienne droite. Rayons de la dorsale, de l'anale et des pelviennes indistinctement bifides ; 2 rayons latéraux de la caudale simples, les autres bifides. Plis radiaux bien marqués. Papille urinaire volumineuse, insérée devant le premier rayon de l'anale, auquel elle est attachée. Anus percé sur la face aveugle, à côté de la papille urinaire. Ligne latérale brièvement et rectilinéairement prolongée sur la région supra-temporale, en direction de l'œil dorsal. Espace interoculaire squameux. Ecailles de la région céphalique à peine plus petites que celles de la région abdomino-caudale, lesquelles sont presque toutes d'égale grandeur entre elles ; leurs spinules marginales courtes, homogènes, non ou à peine saillantes hors de l'épiderme.

Face aveugle.—Tube nasal antérieur cylindrique, gros et assez long, libre, inséré au-dessus du quart antérieur de la longueur de la bouche et à une distance du sillon labial au moins égale à la largeur d'une écaille ; étant couché en arrière, son extrémité atteint presque l'aplomb du milieu de la fente buccale. Narine postérieure percé à l'extrémité d'une tubulure à base vésiculeuse, insérée au-dessus du niveau de la base du tube antérieur et sur l'aplomb du milieu de la fente buccale. Franges sensorielles représentées par des cils courts et fins, épars. Une ligne sensorielle rostro-dorsale longeant la base de la dorsale sur la région céphalique ; une autre ligne sensorielle, longitudinale, prolongeant en avant la ligne latérale et passant immédiatement au-dessus de l'aire nasale. Ecailles un peu plus petites que celles de la face oculée ; leur champ spinuleux très réduit, mais distinct. Nageoires nues, comme sur la face oculée ; plis radiaux très développés.

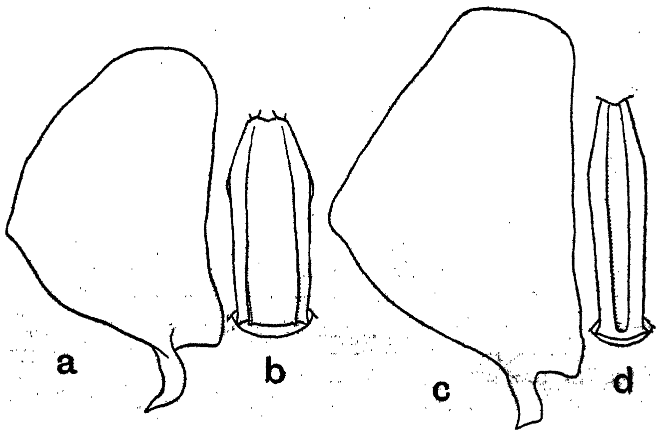
Coloration en alcool.—Face oculée d'un brun grisâtre, foncé, densément et finement ponctuée de noir. Face aveugle d'un brun plus clair, uniforme.

Entre autres caractères discriminatifs, *Aseraggodes melanostictus*, Peters, possède les particularités suivantes : pelviennes symétriques, à base courte et oblique, largement séparées l'une de l'autre postérieurement ; leur rayon antérieur inséré au dessous de la moitié postérieure de l'espace postoculaire ; papille urinaire libre, insérée sur la droite du

In *armatus* the two central keels are weaker anteriorly; median area obviously narrower than either the adjacent or the lateral areas, which are of about equal width, the lateral (pleural) area being slightly the narrower.

Abdomen.—First segment about four times as long as wide. Petiole expanding to spiracles and postpetiole narrowing again posteriorly. Four complete sharply raised longitudinal keels, two dorsal and two lateral. In *armatus* the first segment is much more depressed—about two and a half times as long as wide—and the dorsal pair of keels often ill defined. Postpetiole more parallel-sided.

Fig. 2.



a, stipes (♂), and *b*, first terminal segment (♀), of *Agriotypus armatus*, Curt.; *c* and *d*, the same of *A. gracilis*, sp. n.

♂.—Differs little from *armatus*, from which, however, it can be separated by the more elongate first abdominal segment, which is as much as six times as long as broad (cf. *armatus*, three and a half to four times). Postpetiole not depressed.

Genitalia more prominent and absolutely larger than in *armatus*. Stipes apically truncate, with upper edge straight. Longer arm of the inner clasper (volsella) rather more slender (about nine times as long as medianly broad) than in *armatus* (about 7 : 1).

♂.—Length about 6 mm.; expanse about 10 mm.

♀.—Length about 7 mm. (ovip. ·5 mm.); expanse about 11 mm.

Described from the following material:—3 ♂♂, 3 ♀♀ (holotype ♀, allotype ♂, and paratypes), Japan, Lake Hakone, 25. iii. 1929 (C. P. Clausen Coll.).

Holotype, allotype, and paratypes in British Museum, London. Paratypes (♂, ♀) in U.S. National Museum, Washington. The occurrence of *Agriotypus* in Japan is interesting (*a*) as a considerable extension eastwards of the known range of the genus (*A. armatus* inhabits N.W. and Central Europe to about latitude 60°, but its presence in Russia * is unknown); (*b*) because of the character of the differences just noted (these are mainly comparative, yet a new name for the Japanese insect appears to be amply justified); (*c*) *A. armatus* is with us found flying over rather fast streams, whereas the new material comes from a lacustrine habitat.

XXIII.—*A Third Species of the Nematode Genus* Thubunæa. By H. A. Baylis, M.A., D.Sc.

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Up to the present only two species of *Thubunœa* appear to have been described—*T. pudica*, Seurat, 1914, from various North African reptiles, and *T. parkeri*, Baylis, 1926, from certain Peruvian lizards. Mr. H. W. Parker, in examining a lizard from Uganda collected by Capt. C. R. S. Pitman, recently found a number of Nematodes, which he kindly handed to the writer. These prove to belong to a third species of *Thubunœa*, remarkable for the asymmetrical structure of its lips. The host is *Mabuya maculilabris* (Gray), and the locality near the River Aswa, east of Paranga, Northern Province, Uganda. The worms were found in the mouth and œsophagus of a preserved specimen. Their proper habitat was doubtless the stomach.

The following is a brief description of the species:—

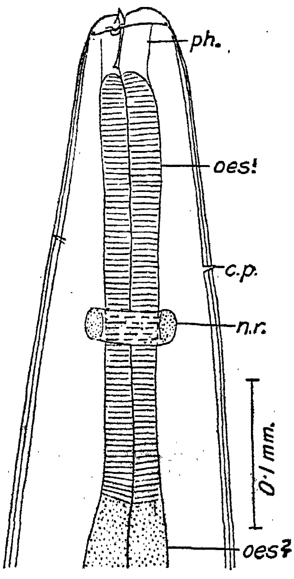
Thubunœa asymmetrica, sp. n.

Length of male 6–7·5 mm.; length of female 10·8–14·8 mm.; maximum thickness, male 0·19–0·25 mm., female 0·26–0·38 mm. Lips asymmetrical, the left lip smaller than the

* Professor M. N. Rimsky-Korsakov, in a recent letter (December 31st, 1929) to Mr. B. P. Uvarov, writes: "There are absolutely no records of the occurrence of *Agr. armatus* in Russia, and I have never collected it. I have only a few cases of Trichoptera with pupæ of a parasite (there are the characteristic 'bands' on the cases), which were sent to me from the Northern Caucasus by Prof. Tarnogradsky. I exhibited [illegible] the Entomological Society two years ago."

right and bearing on its inner surface three forwardly-directed teeth, while the right lip is unarmed. A cuticular groove surrounds the anterior end of the body at the bases of the lips. Cephalic papillæ not made out. No lateral alæ. Œsophagus and pharynx as in other species. Distance from anterior extremity to end of pharynx 0·035–0·05 mm.; to

Fig. 1.



Thubunæa asymmetrica. Anterior end of young female; dorsal view. *c.p.*, cervical papilla; *n.r.*, nerve-ring; *oes.*[1], *oes.*[2], anterior and posterior portions of œsophagus; *ph.*, pharynx.

end of anterior division of œsophagus 0·2–0·35 mm.; to end of entire œsophagus 1·45–2·4 mm. Nerve-ring and excretory pore in posterior half of anterior portion of œsophagus, usually towards its posterior end. Cervical papillæ rather prominent, somewhat in front of nerve-ring.

Caudal end of male usually curved ventrally, and with numerous papilliform cuticular elevations on its ventral surface. Among these the terminations of the true papillæ may be distinguished by their greater size. Of these there seem to be usually 11 on the right side and 12 or 13 on the left. Tail about 0·4 mm. long. A pair of unequal spicules present. These are feebly chitinized but quite distinct structures,

The left spicule measures 0·08–0·1 mm. in length, the right 0·065–0·08 mm.

Tail of female short (0·1–0·16 mm.), conical. Vulva at 1–1·7 mm. from anterior end of body. Vagina and two

Fig. 2.

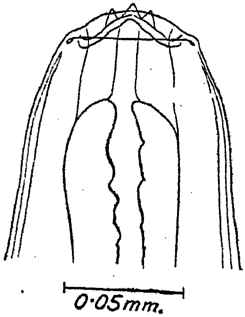
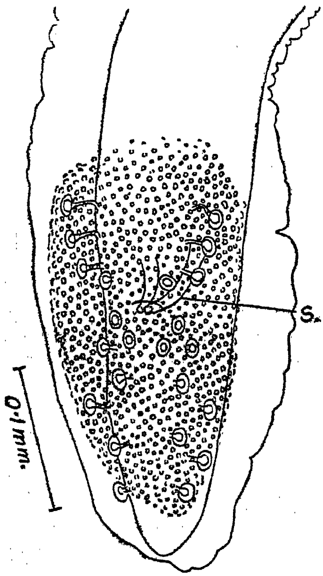


Fig. 3.



Thubunæa asymmetrica.

Fig. 2.—Head of female, viewed from left side.
Fig. 3.—Posterior end of male; ventral view. *s.*, left spicule.

parallel uterine branches run posteriorly. None of the specimens contained fully formed eggs.

This species differs from both the previously described forms in the asymmetrical structure of its lips. In *T. pudica* and in *T. parkeri* each lip bears three teeth. Spicules appear to be absent in the male of *T. parkeri*, while the spicules of *T. pudica* are, according to Seurat, subequal and 0·15 mm. long.

References.

Baylis, H. A. 1926. "On a new Species of the Nematode Genus *Thubunæa*." Ann. & Mag. Nat. Hist. (9) xviii. pp. 361–364.

Seurat, L.-G. 1914. "Sur un nouveau Nématode parasite des Reptiles." Compt. Rend. Soc. Biol., Paris, lxxvi. pp. 724–727.

XXIV.—*A new Alpine Grasshopper* (*Orthoptera*, Acrididæ) *from Mount Elgon.* By B. P. Uvarov.

Paracomacris elgonensis, sp. n.

Differs from other species of the genus by abbreviated elytra and wings.

♂ (*type*). Antennæ thick and short, not reaching the hind margin of the pronotum, slightly flattened in the basal portion, strongly punctured in the apical half.

Face very oblique. Frontal ridge convex in profile, gradually diverging downwards, sulcate throughout except between the antennæ. Fastigium of vertex strongly prominent forwards, narrowly oval, half again as long as broad, surface convex.

Pronotum twice as long as its greatest width; median carina strongly raised, sharp; disc obtusely tectiform, slightly concave on each side of the median carina, in the metazona with longitudinal rugosities; lateral carinæ well developed in the prozona and obtuse in the metazona; typical sulcus deep, placed behind the middle; hind margin of the disc obtusely angulate. Lateral lobes about as high as long, trapezoidal; lower margin obtusely angulate.

Elytra reaching the middle of hind femora, narrow, with the main veins raised and practically straight. Wings shorter than the elytra.

General coloration dark brown; face blackish; occiput with two irregular divergent black stripes; pronotum with a deep black median stripe and with edge of the median carina brown; a black stripe on the sides of the head and in the upper portion of the lateral pronotal lobes; the lower portion of the lobes buff. Hind femora with blackish knees; hind tibiæ dark brown.

♀ (*paratype*). Antennæ relatively shorter than in the male. Frontal ridge very shallowly sulcate. Fastigium of vertex moderately prominent.

Coloration mainly as in the male; elytra with a whitish line along the radial veins.

Total length, ♂ 12, ♀ 19; pronotum, ♂ 2·5, ♀ 4; elytra, ♂ 5, ♀ 7·5; hind femur, ♂ 8, ♀ 12·5 mm.

Described from two males (including the type) and six females taken by Mr. G. L. R. Hancock at Mudangi, Elgon, Uganda, 20. viii. 1929, at an altitude of 12,000 feet.

One of the females is olive-green above.

So far as I know, this is the first grasshopper to be recorded from the upper zones of Mount Elgon. The species belongs to a genus well represented in the lowlands of tropical Africa, but differs from all its congeners by abbreviated organs of flight—a feature very common in Alpine Orthoptera.

XXV.—*Descriptions of Two new Species of* Latiaxis.

By H. C. Fulton.

Latiaxis finchi, sp. n. (Figs. 2, 2 A.)

Shell rather solid, cream-white; whorls $6\frac{1}{2}$, very angular, with narrow spiral ribs, of which there are about thirty on last whorl, coronated at shoulder-angle with short hollow

Fig. 1. Fig. 2.

Latiaxis winckworthi, sp. n. *Latiaxis finchi*, sp. n.

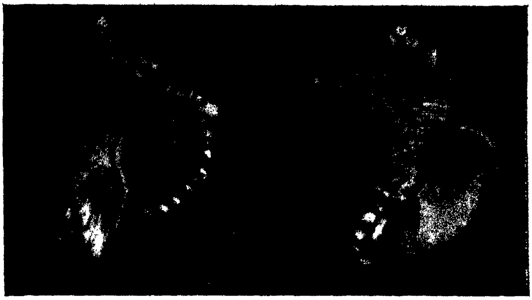
triangular tubercles; aperture pyriform, white within, umbilicus broad at base, diminishing towards the interior; peristome rather thin, serrate at outer margin, anterior canal prolonged and curved.

Maj. diam. 29, alt. 37 mm.

Hab. Kii, Japan.

In form nearest to *deburghiæ*, Rve., but more solid, with shorter and much more numerous spines on its keel.

Fig. 1 A. Fig. 2 A.



Latiaxis winckworthi, sp. n. *Latiaxis finchi*, sp. n.

Latiaxis winckworthi, sp. n. (Figs. 1, 1 A.)

Shell globosely pyriform, whitish, thin; whorls $6\frac{1}{2}$, sharply angled above, with narrow, short, spiral, flattened, tubular spines in regular lines, terminating in axial lines, that give the shell a decussated appearance; aperture ovate, with a prolonged and recurved anterior canal; peristome thin; umbilicus broad and deep.

Maj. diam. 28, alt. 38 mm.

Hab. Kii, Japan.

This elegant and delicate species is quite distinct from other known species of *Latiaxis*; it has some resemblance to a young specimen of *Rapana*. Named in honour of Ronald Winckworth, Esq., M.A.

XXVI.—*Three new Orthoptera from China.* By B. P. Uvarov.

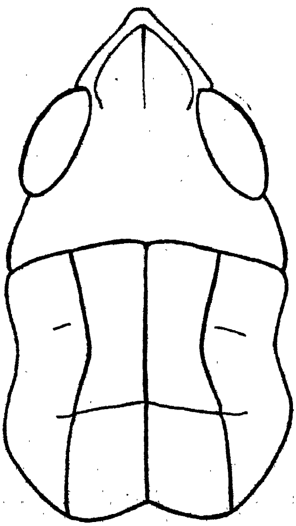
Dr. F. von Emden, Keeper of the Entomological Department of the Staatliche Museen für Tierkunde und Völkerkunde in Dresden, has submitted to me for determination some Orthoptera from Peking and the Szetchuan province collected by the Stötzner Expedition to China. The collection, although small, contained three new species, one of them belonging to a new genus, and they are described below. The types are preserved in the above-named museum.

Acrididæ.

Ptygonotus tarbinskyi, sp. n.

♂. Face oblique. Frontal ridge not sulcate, punctured, with obtusely rounded margins, in profile slightly convex. Fastigium of vertex not longer than broad, obtusely triangular, with a short and low median carinula.

Pronotum with the front margin slightly convex and the hind margin not deeply obtusely excised. Median keel well developed, thick, in profile feebly convex. Lateral keels rounded, incurved in the middle of the prozona, gradually divergent backwards and less so forwards. Typical sulcus distinctly behind the middle.



Ptygonotus tarbinskyi, sp. n., ♂ (type).

Elytra reaching the middle of the third tergite, narrowly lancet-shaped, with narrow rounded apex; main veins raised.

Metanotum and abdominal tergites with a median keel. Last tergite with an obtusely angular excision; its sides straight, with an indentation opposite the edge of the supra-anal plate. Supra-anal plate rounded-trapezoidal, with a short apical lobe. Cerci simple, a little longer than the plate. Subgenital plate elongate, conical.

General coloration pale olivaceous-green. The following parts are black:—a streak closely adjoining each eye on the

vertex; a pair of round dots near the front margin of the pronotum; another pair of similar dots at the front margin of its metazona; a series of dots on tergites, partly fused to form a continuous line close to the median keel; sides of abdomen. Upper portion of lateral pronotal lobes chocolate-brown, this stripe continued also on to the head, reaching the eye. Elytra brownish-olivaceous above, blackish below. Hind femur of the ground-colour, becoming reddish-brown towards the knee, which is dark brown and even blackish laterally. Hind tibia pale reddish.

Total length 14, pronotum 3, elytra 4, hind femur 10 mm.

A single male from Sunpânting, Szetchuan province.

By the shorter fastigium and roundly incurved lateral pronotal keels the new species differs considerably from *Ptygonotus semenovi* recently described*, also from Szetchuan, by Mr. S. P. Tarbinsky, to whom my species is dedicated.

Habrocnemis, gen. nov.

A member of the group Euprepocnemini, similar in the general appearance to *Pareuprepocnemis*, but quite distinct from it in the structure of vertex.

♂. Antennæ practically filiform, slightly flattened, but not expanded. Face well inclined; frontal ridge sulcate, between antennæ slightly rounded-prominent. Fastigium of vertex sloping forward, narrow, pointed at the apex, sulcate, with a feeble median carinula behind; sides of the fastigium bearing distinctly impressed acutely triangular temporal foveolæ. Eyes elliptical, little prominent. Pronotum relatively long, gibbulose, coarsely punctured and rugulose; transverse sulci deep, the typical one behind the middle; median keel well developed, cut by all sulci; lateral keels thick, nearly obliterate; lateral lobes trapezoidal; hind margin of the disc very obtusely angulate. Prosternal tubercle thick, cylindrical, with rounded apex. Mesosternal lobes transverse, separated by an interspace which is narrower than one of the lobes and slightly broader than its own length. Metasternal lobes narrowly separated. Elytra strongly abbreviated, not touching each other by their inner margins. Last tergite excised in the middle. Supra-anal plate rounded, triangular. Cerci small, compressed laterally. Subgenital plate obtusely conical. Front and middle femora incrassate. Hind femora short and thick. Hind tibiæ with seven to eight external spines, but without an apical spine,

* Ann. & Mag. Nat. Hist. (9) xx. 1927, p. 497, fig. 5.

and with nine internal ones, including the apical one. Hind tarsi normal.

Genotype, *Habrocnemis sinensis*, sp. n.

Habrocnemis sinensis, sp. n.

♂. Antennæ reaching a little beyond the hind margin of the pronotum.

Frontal ridge deeply sulcate throughout, gradually and feebly widened downwards. Fastigium of vertex with the raised lateral margins practically parallel in the posterior half and convergent to a point in the anterior.

Pronotum distinctly gibbose in profile, coarsely punctured and rugulose. Metanotum and abdominal tergites with a median carinula.

Elytra extending a little beyond the metanotum, oval, with their greatest width behind the middle, and the apex rounded.

Last tergite in the middle behind with a narrow trapezoidal excision reaching the foregoing tergite; the portions of the tergite on both sides of the excision are strongly chitinized and black. Supra-anal plate somewhat longer than broad, triangular in its general shape, but the sides are distinctly convex. Cerci a little longer than the plate, somewhat compressed laterally, the apical part strongly compressed and feebly decurved, the apex itself acute. Subgenital plate very obtusely conical.

General coloration pale buff, but with broadly developed black pattern. Antennæ brownish. Face pale buff, with narrow shining black markings round the base of antennæ and under the lower margin of the temporal foveolæ. Head above buff, with a median and a pair of postocular stripes of brown colour. Pronotal disc with a broad blackish-brown median stripe, which becomes paler between the sulci and is included between two practically parallel, sharply defined, buff lateral stripes. Lateral pronotal lobes blackish brown; an oblique triangular spot at the front margin, more than posterior half of the lower margin to about one-third of the height of the lobes, and a minute callous spot between the second and the third sulcus are buff. Pleuræ black, with an oblique buff stripe. Sides of abdominal tergites with large shining black spots, rounded behind, and leaving free the hind margin of each tergite. Hind femora on the outer face olivaceous, becoming blackish near the upper lateral carina; upper side buff, indistinctly banded with olivaceous; inner face and lower inner sulcus black, with a pale preapical ring; knees blackish laterally, but the knee-lobes buff. Hind

tibiæ red, fading into dirty yellowish basally; spines black-tipped. Elytra blackish brown, with paler stripes along the anal veins.

Total length 21, pronotum 6, elytra 5, hind femur 12 mm.

A single male from Tatsienlu, Szetchuan province.

The shape of the frontal ridge, which is slightly projecting forwards between the antennæ, and the structure of the vertex in this curious insect remind one somewhat of *Traulia.* Indeed, one would be perhaps equally justified in regarding the new genus either as a member of the group Euprepocnemini, or of Trauliini. These groups are usually far removed from each other in the linear arrangement of the genera, but their chief difference is based on the presence or absence of lateral pronotal keels, a character which varies considerably within both groups. The new genus may be therefore regarded as to some extent connecting the two groups, and I am inclined to include it in Euprepocnemini rather than in Trauliini.

Tettigoniidæ.

Deracantha transversa, sp. n.

Intermediate in size between *D. onos*, Pallas, and *D. grandis*, Lucas, but relatively more broad-shouldered than any of them, and apparently resembling in this respect the very poorly described *D. cincta*, F. W.

♂ (*type*). Pronotum relatively large; its greatest width is two-thirds of its length. Prozona with the anterior margin concave; its disc transversely impressed; hind lateral angles well prominent, less obtuse than in *D. onos* or in *D. grandis*, with a distinct small circular pit at the base of the prominence. Metazona (*i. e.*, the whole of the pronotum behind the constriction) scarcely longer than wide; lateral margins straight, tuberculate, with a minute spinule at the antero-lateral angle; hind margin of the disc straight in the middle, broadly rounded and with some obtuse conical tubercles on the sides; disc strongly wrinkled and punctured, with a deep and broad transverse impression in front of the middle, with a pair of deep irregularly shaped pits just behind the typical sulcus; the posterior portion of the metazona (lying behind the transverse impression) is distinctly broader than long, with a large transverse gibbosity and two broad, shallow, sublateral concavities behind the latter. Lateral lobes concave and minutely wrinkled in the metazona, smooth otherwise, much longer than deep; anterior margin slightly

concave; lower margin straight in prozona, rounded-prominent opposite the lateral angle of the metazonal disc, broadly rounded in the rest. Abdominal tergites punctured, with the hind margins smooth, but not inflated. Last tergite with a pair of short conical appendages at the sides of the round median emargination. Cerci thick, with a conical tubercle on the inner margin behind the middle and a spinule on the inner side of the conical apical portion.

General coloration brownish buff. Pronotum above blackish brown along the lateral margins, the colour extending more deeply inwards on the impressed portions of the disc; lateral lobes chocolate-brown, broadly pale below. Abdominal tergites with transversely placed black spots.

♀ (*paratype*). Pronotum relatively smaller than in the male; tubercles and spinules on its margins more distinct and acute. Ovipositor nearly twice as long as the pronotum, moderately recurved.

Total length, ♂ 44, ♀ 40; length of the whole pronotum, ♂ 18, ♀ 16; length of metazona, ♂ 13, ♀ 11; width of metazona, ♂ 12, ♀ 11; hind femur, ♂ 22, ♀ 17; ovipositor, ♀, 30 mm.

Described from 2 ♂♂ and 5 ♀♀ from Peking.

D. transversa, sp. n., is quite distinct from *D. onos* and *D. grandis* by the characters indicated above, as I am able to state after a direct comparison with the topotypical specimens of those two species. As regards *D. cincta*, F. W., it has been very briefly described, so that a comparative study appears impossible. I think myself justified, however, in expecting a species of *Deracantha* from Peking to differ from one described from Siberia. Judging by the figure of *D. cincta*, which is very poor, it appears that the latter species has a very short pronotum, but this may be due to a mistake of the artist.

MISCELLANEOUS.

On Phylactolæmatous Polyzoa from Tahiti: a Correction.

In my article "Notes on some little-known Phylactolæmatous Polyzoa and Description of a new Species from Tahiti" (Ann. & Mag. Nat. Hist. (10) iii. pp. 300–310, March 1929) the following correction should be made:—

On p. 309, line 11, delete the word "floating."

Anna B. Hastings.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[TENTH SERIES.]

No. 27. MARCH 1930.

XXVII.—*The* Calostylidæ, *Roemer: a Family of Rugose Corals with Perforate Septa.* By STANLEY SMITH, M.A., D.Sc., F.G.S.

[Plates X.–XII.]

I. INTRODUCTION.

Several new species of the perforate Rugose coral *Calostylis*, Lindström, have recently come under my notice. In naming and describing these it is necessary to consider some of the forms already known, and thus an excellent opportunity arises of revising the Calostylidæ and of discussing the systematic position of *Calostylis* and *Helminthidium* in the light of new evidence.

I am very much indebted to Dr. F. L. Kitchin and Mr. John Pringle for placing at my service the Silurian corals recently collected by members of H.M. Geological Survey in Shropshire, and for supplying me with precise information concerning the stratigraphical horizon and locality of the specimens; and to Dr. W. D. Lang for access to the type-specimens of *Calostylis lindstromi*, Nicholson & Etheridge, and "*Hemiphyllum siluriense* (M'Coy)" of Tomes (here renamed *Calostylis tomesi*), for the loan of much material, and for other help.

I also thank Dr. J. Ernhold Hede for lending me specimens of *Calostylis denticulata* (Kjerulf), from the Riksmuseet, Stockholm, and determined by the late Prof. Gustav Lindström; and Prof. A. F. Foerste for presenting me with some of the original material of his *Calostylis spongiosa*.

II. The *Calostylidæ*, Roemer, 1883, pp. 334, 393.

Diagnosis.—Simple and compound Rugose corals, often of unusual shape and peculiar growth-habits; with septa which are perforate and have partially or entirely degenerated into a meshwork of anastomosing strands. The trabecular elements of any one septum may end freely, or may unite with those of a neighbouring septum, and thus build up spongy tissue which either forms a peripheral zone and axial column to the coral or entirely fills its interior.

Type-genus: *Calostylis*, Lindström.

C. F. Roemer, 1883, p. 334, added this family to those which he placed in the Zoantharia Rugosa, and included in it the single genus *Calostylis*, of which the only species then known to him was *C. denticulata* (Kjerulf). I here add *Helminthidium*, Lindström, to the Calostylidæ. In placing *Calostylis* among the Rugose corals Roemer differs from Lindström (1870, p. 3), Nicholson & Etheridge (1878, p. 64), Nicholson (1879, p. 195; 1889, p. 307), and Duncan (1884, p. 184), all of whom reasonably though erroneously included the genus in the Eupsammidæ, a family of the "Zoantharia Perforata," for not only do the members of the Calostylidæ resemble those corals in their perforate and trabeculate septa, but many of them also show other characters which suggest the younger rather than the older Zoantharians *. Among later palæontologists, Neumayr (1889, p. 279), Frech (1890, p. 46), Koken (1896, p. 307), Gürich (1908, p. 38), Robinson (1917, p. 173), and Foerste (1917, p. 203) have followed Roemer and Bernard (1904, p. 19) on entirely different grounds, arriving at the same conclusion. Others, however, including Zittel, have adhered to Lindström's idea.

* *Calostylis tomesi*, with its smooth epitheca ending before it reaches the rim of the calice, recalls *Montlivaltia trochoides*, Edwards & Haime; the discontinuous bands of epitheca in *C. denticulata* are paralleled in species of *Thecosmilia*; and the expansion of the coral round the proximal end, seen in various species of *Calostylis*, is unusual in Rugose Corals, but common in the Aporosa.

Weissermel (1927, p. 4), in his interesting paper on the development of the Rugose corals into the Hexacoralla, remarks that a perforate condition is a secondary one, and that it is therefore a mistake to link up the isolated perforate forms of the Palæozoic period with the younger perforate corals.

In view of these differences of opinion held by competent workers, a few remarks upon the perforate Aporose corals are not out of place here, but such remarks must be brief. These corals, which are principally Tertiary and Holocene, but have some Cretaceous ancestors, and must include the Jurassic Thamnastræidæ, all have tissue (septal, cœnochymal, or both) which has become perforate and spongy. Four families are recognized—the Eupsammidæ, Poritidæ, Madreporitidæ, and Thamnastræidæ. Edwards and Haime (1850) placed the first three of these families into the Zoantharia Perforata, one of the five suborders into which they divided the Zoantharia, and the Thamnastræidæ with non-perforate Hexacoralla into the Zoantharia Aporosa, implying genetic distinction between the two groups. Most of the subsequent writers have followed Edwards and Haime, but have transferred the Thamnastræidæ from the "Aporosa" to the "Perforata."

The Perforata can no longer be regarded as a phyletic unit, but must be looked upon as a group of Aporose corals belonging to a number of lineages. The Eupsammidæ are, for the most part at any rate, modified Turbinolidæ, and the Thamnastræidæ are descended from non-perforate Astræid ancestors *. Gerth (1908), in an interesting and suggestive paper, derives the Poritidæ from the Astræid genera *Stephanocœnia* and *Astrocœnia*, and the Madreporitidæ partim from *Heterocœnia*; but he is less convincing when he links these with the Palæozoic *Protarea* and *Propara*.

The same modification of structure, but affecting the walls and connecting tissue, is also to be found in certain Tabulate corals as well as in the Hydrocorallinæ. It is noteworthy that this degeneration of tissue, at any rate in corals, is often accompanied by a marked tendency to take on an unusual shape, as in the two Eupsammids here figured, in the Tabulate *Palæcis*, e. g., *P. axinoides*, Smyth, 1929, pls. vi.–viii., and the Calostylids themselves.

The Calostylidæ are the only group of perforate Rugose corals yet described, and it is of interest to note that they appear very early in the history of the Anthozoa—the Upper

* Lang, 1917, pp. 91–94.

Valentian period; also that, so far as is known, they do not survive the Silurian epoch. Despite the contrary views that have been expressed regarding the systematic position of *Calostylis*, the fact that it belongs to the Tetracoralla, and not to the Hexacoralla, can now be claimed as having been definitely established; for, although the reasons evinced by Roemer were not perhaps in themselves conclusive, I am able to confirm Frech (1890) in showing that its septa entirely conform with those of other Rugose corals in their development and arrangement, and occurring in two distinct cycles. This is most conclusively demonstrable in the case of *C. roemeri*, sp. n. (Pl. X. fig. 1), since the epithecal fluting clearly shows the outcrop of the cardinal and two alar fossulæ and that the septa are inserted on perfectly normal lines. The fossulæ are, however, seldom obvious either in the calices or in transverse sections. I have only noticed them in a few instances in the former, and never been able to recognize them with absolute certainty in the latter. This can be accounted for partly by the uneven lengths and generally irregular character of the septa. The septa are alternately long and short, as in other Rugose corals, and the two cycles are usually quite distinct; in the smaller species, in fact, the minor septa are very much shorter than the major, but in the genotype—*C. denticulata*—the former attain almost the same length as the latter, and it is therefore not altogether surprising that Lindström interpreted the symmetry of the septa in this species as indicating an Aporose coral*. In the early stages of the coral the structures are almost invariably masked by stereome.

The structure of *Helminthidium* is such that, were it not that this remarkable coral is united with *Calostylis* by intermediate forms, its systematic position must necessarily have remained doubtful. As it is, however, the one merges into the other, and thus the Rugose affinities of both are satisfactorily established.

Finally, before I proceed to discuss separately the two genera and to describe the species of *Calostylis* and *Helminthidium*, a few general remarks upon the structure of the septa are necessary. In *Calostylis* the septa are partly lamellar, as in normal Rugose corals, but even then the lamellæ are perforated by round pores, so that in transverse section this part of the septum appears to be discontinuous,

* He supposed that the septa were inserted in several cycles, and remarks (1870, pp. 4–5), "Judging by young specimens possessing 24 septa, they seem to be arranged in four cycles, but it is difficult to make out their order or discern the different cycles."

and resembles a row of dots and dashes. Peripherally, and in the case of the major septa, axially as well, the pores become more numerous and the septa break down into a meshwork of trabeculæ. Such structure is illustrated more clearly than in any section by the corroded specimen of *C. spongiosa*, Foerste, reproduced in Pl. XII. fig. 4, which exposes an interior which fortunately is free of mineral matter. Although peripherally the septa may not altogether lose their individuality, the trabeculæ unite them into a continuous spongy zone. Axially the degeneration is even more complete, and the axial column is formed of septal elements thoroughly broken down into a network of anastomosing tissue. The individual strands of this peripheral and axial tissue are not of uniform thickness, but, though filamentous, yet dilate so as to form numerous rounded nodes, and the numerous free endings are nearly always swollen and rounded. The well-preserved material of *C. denticulata* from Gotland proves that the septa are built up of steeply inclined fibres whose convexity is towards the outside of the coral. These minute details are shown in the much enlarged figures of a longitudinal and a transverse section of the coral (Pl. X. fig. 24; Pl. XI. fig. 7).

In *Helminthidium* the septal elements are wholly in the form of trabeculæ and of the same structure as those in the axial parts of *Calostylis*, but are more compact. It is interesting to note that these slender cylindrical corals not only have the structure but also the form of the axial column of their ally *Calostylis*.

III. *Calostylis*, Lindström, 1868.

Diagnosis.—Simple and compound Calostylidæ, in which the shape of the corals and the character of the epitheca vary very much, in which the septa are perforate and break down into trabeculæ both axially and peripherally, and in which true tabulæ are present.

Genotype.—*Calostylis cribraria*, Lindström, 1868, p. 421, pl. vi. figs. 1–3; Salopian, Gotland = *Clisiophyllum denticulatum*, T. Kjerulf, 1865, pp. 22, 25, fig. 32 on p. 25.

Typical specimens of most species are distinct, but may grade from one species to another, and individuals are found which occasionally exhibit some character typical of another species. On the whole, however, the different species are more readily distinguished by shape and epithecal character than by their internal structures, which depend to

a very great extent upon the size and form of the corals. In all the smaller species the septa are usually irregular, often wavy, and the minor septa as a rule are very short. In these characters the septa resemble the earlier stages of *Calostylis denticulata*. Two well-marked trends are pursued—on the one hand, the progressive *C. denticulata* trend, in which all the septa take on a more regular form and the minor septa almost attain the length of the major, on the other hand, the degenerate *Helminthidium* trend, in which the septa deteriorate and lead on to the *Helminthidium* condition (see p. 272).

The transverse tissue consists of thin, unmodified, distally arched tabulæ, which are best developed in the large species *C. denticulata*. I am uncertain as to whether dissepiments ever occur; I have noticed some small curved plates near the periphery, but only in *C. denticulata*, and these were not clearly differentiated from the tabulæ.

The calice presents much the same appearance and varies similarly in all the species. It is shallow, concave, has a wide rounded rim, and usually a prominent central boss, though not always, for in some cases the axial column does not project above the floor. Both septa and axial column stand out in high relief, clearly revealing their structure.

Calostylis roemeri, sp. n. (Pl. X. figs. 1–5 & 23.)

Diagnosis.—Small, simple, typically trochoid *Calostylis*, with a strongly fluted epitheca.

Description.—The corals are typically widely horn-shaped, with a more or less strongly curved proximal end (Pl. X. figs. 1 & 4); but turbinate forms (Pl. X. figs. 2 & 3) and specimens which have grown tall and cylindrical are common. Generally the coralla are not more than 20 mm. long and are less than 15 mm. in diameter. The epitheca, which does not extend quite to the level of the calice (Pl. X. figs. 2 & 3), is in most cases transversely wrinkled, and always striated longitudinally; this strong epithecal fluting is diagnostic of the species. The grooves and ridges show, as in other Rugose corals, the position of the cardinal and alar fossulæ (Pl. X. fig. 1).

Internal Structures.—The axial column and peripheral zone are well defined (Pl. X. fig. 5). The former is rather small, but the latter is distinctively wide. The major septa are straight and reach the axial complex, but the minor septa, as in all the other small species of *Calostylis*, are usually very short, and do not extend far beyond the peripheral

zone. A few distant and distally arched tabulæ can be seen in longitudinal section continuing through the axial complex. Much stereome is invariably present, intensifying the tissue and sometimes even completely filling up the interstices of the coral.

Holotype and Paratypes.—Museum of Practical Geology.

Holotype.—Specimen 48598 (Pl. X. fig. 1).

Paratypes.—Specimens 49599, 48600 (Pl. X. fig. 2), 48601, 48602, 48603, 48604, 48605, 48634 (Pl. X. fig. 3), 49000, and 49001. Sections $\frac{M}{701}$, $\frac{M}{702}$, $\frac{M}{703}$, $\frac{M}{704}$, $\frac{M}{705}$, $\frac{M}{706}$, $\frac{M}{707}$, and $\frac{M}{710}$. ($\frac{M}{701}$ and $\frac{M}{710}$, transverse and longitudinal sections of the same specimen; $\frac{M}{702}$ and $\frac{M}{703}$ were cut from specimen 48599.) Valentian *Pentamerus*-beds, right bank of Morrells Wood Brook, 300 yards N.N.E. of Morrellswood Farm, 1 mile N.N.W. of Buildwas (3 miles N. by E. of Much Wenlock), Shropshire. 48635 (Pl. X. fig. 4): Valentian. Purple Shales, left bank of Sheinton Brook, 440 yards N.W. of Old Mill, Sheinwood, 1½ miles N.E. of Harley Church (2 miles N.W. of Much Wenlock), Shropshire.

Remarks.—*Calostylis roemeri* is extremely common, in fact the commonest coral in the thin encrinital limestone, very rich in fossils, which is found in the *Pentamerus*-beds, near Buildwas. Externally it is more like a typical Rugose coral than are the other species here described, whilst internally it is somewhat generalized, and thus resembles the other small forms of *Calostylis*; but the well-developed peripheral zone is a distinctive feature. It may very well be the parent-species from which the other Valentian and the Salopian Calostylids are derived. On the other hand, *C. lindstromi* from Ayrshire and the Gotland *C. denticulata* may have descended through other branches from a still older and unknown common ancestor of Lower Valentian or even Caradocian age.

Calostylis togata, sp. n. (Pl. X. figs. 6–8.)

Diagnosis.—Small, simple, cylindrical, or trochoid *Calostylis*, with an unevenly developed epitheca, which is thin over most of the coral, but is thick near the proximal end.

Description.—The corallum varies in shape; it is irregularly cylindrical in typical specimens, but it may be trochoid. The epitheca is very thin over most of the coral, but is more strongly developed in some places than in others, and

particularly near the proximal end, which is typically enveloped by the overfolded coral tissue as by a mantle.

The few specimens known to me suggest that the species is rather larger than *C. roemeri*. Although the holotype (Pl. X. fig. 6) is only 13 mm. high and 14 mm. wide, specimen 48608, a trochoid form from which section $\frac{M}{708}$ (Pl. X. fig. 8) was cut, was nearly 20 mm. in length, and has a diameter of approximately 20 mm.

Internal Structures.—The septa are thin, straight, and regular, and the minor septa are long. In section $\frac{M}{708}$ there are about 45 septa in each cycle. The axis is narrow, but the peripheral zone is very wide.

Holotype and paratypes.—Museum of Practical Geology.

Holotype.—Specimen 48610 (Pl. X. fig. 6). Valentian. Purple Shales. Section on left bank of a tributary of Hughley Brook, 60 yards W. of its junction with the main stream, and 450 yards S.W. of Hughley Church ($3\frac{1}{2}$ miles S.W. of Much Wenlock), Shropshire.

Paratypes.—Specimen 48611, same horizon and locality as holotype; specimen 48608, Valentian, Purple Shales, section on right bank of another tributary of Hughley Brook, 180 yards W. of its junction with the main stream and 720 yards S.W. of Hughley Church.

Remarks.—The forms which I have called "*togata*" are clearly allied to the common Valentian species *C. roemeri*, of which, in fact, they may be individual variations. Specimen 48609 (from the same locality as 48608) is intermediate between the two species. At the same time, in the character of the epitheca and of the septa it so closely approaches the Salopian *C. denticulata* that it would be extremely difficult to distinguish *C. togata* from a small, less typical specimen of that very variable Gotland species.

Calostylis aberrans, sp. n. (Pl. X. figs. 9–17.)

Diagnosis.—Small tumid *Calostylis*, with a slender cylindrical stalk.

Description.—This remarkable form includes small individuals of most unusual shapes. The corals may be globular, pear-shaped, or hemispherical, but have a more or less well-developed proximal stalk, and sometimes a distal stalk-like prolongation. The calice is indifferently slightly concave or strongly convex as described for *Helminthidium mirum* (p. 273).

The corals appear to be simple, but the dumbbell-shaped holotype (Pl. X. fig. 9) consists of two individuals, one of which has either attached itself to the side of the other or has budded from it. The epitheca may be smooth or strongly wrinkled.

Internal Structures.—In the expanded part of the corallum these are similar to those in the other small species of *Calostylis*, the transverse section resembling more particularly that of *C. lindstromi*, but in the attenuate region referred to as the "stalk" they are in the condition of those in *Helminthidium*.

Holotype and paratypes.—Museum of Practical Geology.

Holotype.—Specimen 48613 (Pl. X. fig. 9), Purple Shales, Valentian. Section on left bank of Sheinton Brook, 440 yards N.W. of Old Mill, Sheinwood, 1½ miles N.E. of Harley Church, Shropshire.

Paratypes.—Specimens 48607 (Pl. X. fig. 11), *Pentamerus*-beds, same locality as the holotype of *C. roemeri*; 48606 (Pl. X. fig. 12), 48633 (Pl. X. fig. 10), Purple Shales, same locality as holotype of *C. togata*; 48612 (Pl. X. fig. 14), 48614 and 48615 (Pl. X. fig. 13), Purple Shales, same locality as holotype of *C. aberrans*. Section $\frac{\text{M}}{709}$, Valentian, Purple Shales. Section on right bank of tributary of Hughley Brook, 180 yards W. of its junction with stream, and 720 yards S.W. of Hughley Church.

Remarks.—Typical members of *Calostylis aberrans*, some of which are extremely small (specimen 48633 (Pl. X. fig. 10) is only 7 mm. long), superficially suggest sponges rather than corals. These extraordinary forms are linked to the very ordinary-looking *C. roemeri* by intermediate variations (48612 (Pl. X. fig. 14)).

Calostylis lindstromi, Nicholson & Etheridge.
(Pl. X. figs. 18–22.)

Calostylis lindströmi, H. A. Nicholson & R. Etheridge, jun., 1878, p. 65, pl. v. figs. 2, 2 *a–c*.

Diagnosis.—Small scolecoid* *Calostylis*, with annular constrictions and transversely wrinkled epitheca.

Description.—This vermiform species is simple, or has rarely lateral buds, although, as pointed out by Nicholson and Etheridge, not more than one such bud has been noticed on any individual. The corallum is cylindrical, but is always more or less twisted, sometimes considerably so,

* Worm-like. Formed in keeping with "trochoid," "dendroid," etc.

and characterized by alternate swellings and constrictions, and has a curved and tapering proximal end. The epitheca is transversely wrinkled, and since it is almost always corroded, the septal edges generally show up as faint longitudinal striæ. The largest specimens I have seen were 25 to 30 mm. long and 5 to 6 mm. in diameter.

Internal Structures.—These are not distinctive. The axis is loosely built and ill-defined, but the peripheral zone, which, in comparison to the size of the coral, is rather wide, is more compact and more distinct. The major septa, although much broken up, are usually fairly straight, and the minor do not project very far beyond the peripheral zone. It is difficult to count the septa; I consider there are about 20 in each cycle; Nicholson and Etheridge believed there were 30 major septa, but this number is too high in my opinion. These authors also remark that "on each side [of the axial complex] delicate and remote plates representing tabulæ can be detected." I have not noticed such plates in any of the sections I have cut, but have no hesitation in accepting the statement. The corals are often filled up with stereome, which obscures all the structures.

Syntypes.—Specimens R. 26210–26253 : R. 26269–71, British Museum (Mrs. R. Gray Collection). Upper Llandovery, greenish mudstones, Penkill, N.E. of Girvan, Ayrshire. These include, however, in addition to specimens of *C. lindstromi*, some fragments of a small cylindrical *Favosites* and some organism encrusting a slender encrinite ossicle. Since the exterior of the material is often ill-preserved, it is not always possible to identify the fossils without cutting them.

Lectotype.—R. 26210 (Pl. X. fig. 18). Specimen figured by Nicholson and Etheridge (pl. v. fig. 2). This is 25 cm. long and 5 mm. in diameter.

Remarks.—*Calostylis lindstromi* approaches *Helminthidium* in shape more closely than any of the other species of the genus here described, but its internal structures are decidedly those of *Calostylis*. No specimens in the Mrs. R. Gray Collection (the only material I have seen) reveal the character of the calices; and the epitheca, as has already been stated, is poorly preserved, so that it cannot be taken into account in considering the specific character of *C. lindstromi*. This species is clearly an early manifestation of the *Helminthidium* trend, but, in my opinion, *Helminthidium mirum* has been derived independently from the Silurian *Calostylis tomesi* and *C. denticulata* (see also "Remarks" under *Calostylis roemeri*).

Calostylis denticulata (Kjerulf).
(Pl. X. fig. 24; Pl. XI. figs. 1–11.)

Clisiophyllum denticulatum, T. Kjerulf, 1865, pp. 22, 25, text-fig. 32 on p. 25. No description of the coral is given beyond explanatory notes to the figure.
Calostylis cribraria, G. Lindström, 1868, p. 421, pl. vi. figs. 1–3.
Calostylis denticulata (Kjerulf), G. Lindström, 1870, pp. 1–6, and subsequent writers.

Lindström (1870, p. 3) stated that he had received from Prof. Theodor Kjerulf specimens of the coral which the latter had figured as "*Clisiophyllum denticulatum,*" and that these were identical with those he (Lindström) had described as *Calostylis cribraria* in 1868. In this paper Lindström gives an excellent description of the coral, and all the allusions to his statements or opinions I make here are to this work.

Diagnosis.—Simple and compound *Calostylis,* often of large size, with an epitheca discontinuously developed, and with thin septa of which the minor are nearly as long as the major.

Description.—The corallum is usually trochoid in its early stages, but grows tall and cylindrical; it is often irregularly developed, sometimes distorted, and sometimes having reached its maximum diameter attenuates distally. Lindström instances a coral 13 mm. in diameter which terminated in a calice only 5 mm. wide.

The corallum may remain simple, in which case it often attains considerable length and diameter (Lindström mentions a specimen 135 mm. long with a calice 35 mm. in diameter), or it may bud and produce colonies which are typically dendroid and consist only of a few corallites, although colonies of a larger growth are occasionally found, such as the one figured here (Pl. XI. fig. 8). Gemmation may be calicular, but it is always marginal and non-parricidal. Young individuals are often seen attached to the sides of the older ones, sometimes in large numbers, as shown in Pl. XI. fig. 11. As Lindström points out, these gemmæ may possibly have originated through larvæ having settled on the older coral, and are not the result of gemmation. The epitheca is always inconsistently developed; it is apparently absent over much of the coral, but is concentrated as horizontal bands, and also drapes the sides with flowing folds, as shown in Pl. XI. fig. 2. These folds may extend downwards for a long distance, and those that reach the

proximal end envelop this in a foot-like expansion of epithecal tissue (Pl. XI. fig. 3), which frequently bears radiciform appendages, and by means of which the coral is attached to extraneous objects. According to Lindström, who gives a very full and very clear account of their character and development, the folds begin "as a small projecting corner or sinus in the border of the calice."

Internal Structures.—In the immature stages of the coral, and in less specialized individuals, these may differ little from those of the other species of *Calostylis* here described; the septa may remain relatively thick and irregular, the minor septa short, and the axial column loosely constructed and not very well defined; there may also be much stereome present. Typical members of *Calostylis denticulata*, however, show a considerable advance upon other species in their ephebic structures. The septa are thin and straight, and although they break down axially and peripherally into trabeculæ, nevertheless can usually be followed individually to the periphery of the coral; the major septa reach the axis, and the minor may extend inwards almost as far; nevertheless, the two cycles are always distinct. The axis is compact and well defined, and the trabeculæ which form it are distinctly stratified as a series of low superimposed domes. The tabulæ are thin and unmodified; round the axis they are concave and horizontally disposed, but they curve upwards both towards the axis and towards the periphery. They persist through the peripheral zone to the limits of the coral, but are more or less completely suppressed or masked within the axial column.

Horizon and Localities.—Salopian. Island of Gotland, Sweden, and Island of Malmö, Norway. It is particularly common in the shales and limestone of Wenlock age in the vicinity of Visby, Gotland. Lindström (1888) gives its range as Horizon *c* and *d* (Wenlock).

Material examined.—Specimens in the Riksmuseet, Stockholm (named by Lindström), British Museum (F. A. Bather Coll.), and in my own collection (these include several that were presented to me by Prof. A. F. Foerste).

Remarks.—In *Calostylis denticulata* the genus *Calostylis* attains its highest development. The species include individuals of large size and colonial forms; and the internal structures, whilst retaining the perforate character of the family, are much better developed than in the other species of the genus.

Calostylis tomesi, sp. n. (Pl. XI. figs. 12–17.)

Hemiphyllum siluriensis, M'Coy, sp.? (*sic*), R. F. Tomes, 1887, p. 99; text-figs. 1 & 2 on p. 99.
?*Calostylis breviuscula*, Nicholson MS., H. A. Nicholson, 1887, p. 174.

R. F. Tomes described this species in the 'Geological Magazine' for March 1887. He thought that it might possibly be identical with M'Coy's *Cyathaxonia siluriensis*, but considered it to represent a new genus, which he named *Hemiphyllum*. Nicholson, in the next issue of the magazine, pointed out that Tomes's corals were not the same as M'Coy's, but were a species of *Calostylis*. He remarked (p. 174), "My friend, Dr. George J. Hinde . . . presented me with specimens of this form, from the Wenlock Shales of Buildwas, some years ago, since which time they have laid in my cabinet with the MS. name of *Calostylis breviuscula* appended to them; but I have never found time to publish a description of the species." Since Nicholson never published an account of his species, the trivial name "*breviuscula*" is therefore a "*nomen nudum*," which it would be unwise to revive, since other small Calostylids have been found in the neighbourhood of Buildwas; I therefore name the species after Tomes.

Tomes mentions most of the outstanding characters of the species, and the only statement of his which calls for special notice and criticism is that there is only one cycle of 26 septa of equal length, which divide into two near the periphery of the coral. The septa are rather more numerous and much less regular than his remarks and figure (fig. 2) suggest, and it is hardly necessary to point out that what he thought to be the forking of the septa is merely the major and minor septa connected by stereome.

Diagnosis.—Small trochoid *Calostylis*, with a smooth epitheca.

Description.—The corals are small, horn-shaped, sometimes widely so (Pl. XI. fig. 14); sometimes rather slender (Pl. XI. fig. 13), and are typically strongly curved. The epitheca, which generally ends several millimetres below the margin of the calice, is smooth, in some cases even polished, although usually there is transverse wrinkling, and often faint longitudinal striation (due to the septa showing through the thin investment). The lectotype (the specimen figured by Tomes) is 20 mm. long, 10 mm. in diameter, and the epitheca ends 4 mm. below the edge of the calice. Most specimens are, however, smaller.

Internal Structures.—These vary considerably in their details in different individuals. There are about 60 septa, of which the minor are very short, the axial complex is loosely constructed, and the peripheral border, so marked a feature in *Calostylis roemeri*, is narrower and much less distinct. The septa may be fairly straight, in which case the transverse section closely resembles that of *C. roemeri*; or they may be much twisted and broken up, when they exhibit internally as well as in the character of the epitheca a distinct *Helminthidium* trend. As in other small species of the genus, the interior of *C. tomesi* may be completely choked up with stereome.

Holotype and Paratypes.—British Museum.

Holotype.—Specimen R. 18446 (Pl. XI. fig. 12) (R. F. Tomes Coll.), Wenlock Limestone, Wenlock.

Paratypes.—Specimens R. 18447, R. 18448 (Pl. XI. fig. 17), R. 18450, R. 18453, R. 18454, R. 18455, R. 18458, R. 18460, R. 26264 (Pl. XI. fig. 16) (R. F. Tomes Coll.), Wenlock Limestone, Wenlock; R. 26143, R. 26144 (Pl. XI. fig. 13), R. 26145 (Henry Johnson Coll.), and R. 2761 (Pl. XI. figs. 14 & 15), and R. 26146 to 26149 (J. E. Gray Coll.), Wenlock Limestone, Dudley.

Remarks.—*Calostylis tomesi*, in my opinion, is the ancestor of *Helminthidium mirum* of same horizon and area. Tomes's specimens include small misshapen cylindrical forms (R. 18449, R. 18451, R. 18452), which might well be regarded as dwarfed individuals of the latter species, but the internal characters of which, so far as one can see—these particular corals are all filled up with stereom—are between *Calostylis* and *Helminthidium*; and I therefore place these as *C. tomesi* of less usual form. There are also other specimens in the British Museum, *e.g.*, 55980, which, although characteristic of the species, are much larger than the typical forms.

The two following species of *Calostylis* have been found in Kentucky and Ohio, North America—in the Niagaran (Middle Silurian):—

Calostylis spongiosa, Foerste. (Pl. XII. figs. 1–7.)

Calostylis spongiosa, A. F. Foerste, 1906, p. 322, pl. vii. figs 3 *a–g*, pl. viii. figs. 1 *a–b*.

Diagnosis.—Rather small *Calostylis*, simple, or only occasionally producing buds, which resemble *C. denticulata* in their variable shape and in the character of the epitheca,

but with feebly developed minor septa, a particularly wide peripheral zone, and a less compact axial column.

Description.—The individuals differ widely in shape—they may be trochoid or cylindrical, but are mostly irregularly developed. The longest specimen received from Prof. Foerste was 35 mm. in length, and the widest had attained a diameter of 15 mm. The calice is similar to that of the other species, and the epitheca shares with *C. denticulata* the same peculiarities of development. In many of the specimens (which are dolomitized, of a brown colour, and of a granular texture) the epitheca has perished.

Internal Characters.—In a section of 15 mm. diameter there are about 50 well-developed septa, which break up axially to form the axial complex. Between these major septa are traces of minor septa which are seen in transverse section as rows of small dots. The trabecular tissue in the wide peripheral zone is thick and close, but in the axial column it is very fine and more open. The tabulæ (Pl. XII. fig. 7) as in *C. roemeri* traverse the axial complex. Prof. Foerste (p. 323) considers his species to differ from *C. denticulata* in its more numerous septa, distinctly smaller septal pores, and absence of branching. Whilst I agree with him in his statement regarding the septa (comparing, of course, specimens of the same size), I cannot see that the pores are smaller in the one species than in the other, although I have cut sections of the two; and as regards branching, although *C. spongiosa* is essentially a simple form, one of the specimens he sent me (Pl. XII. fig. 3) has a lateral bud.

Horizon and Locality.—Waco Limestone, Clinton Formation (Niagaran). Various localities in the vicinity of Irvine, Panola, Waco, Indian Fields, etc., South-East Kentucky, U.S.A. The specimens figured by Prof. Foerste were all from the road north of Estill Springs, north of Irvine.

The figured syntypes were lost in the Dayton flood of 1913, but Prof. Foeste has other specimens, some of which he very kindly sent me. I have placed these in the British Museum, and they have been registered under the numbers R. 26528–R. 26533.

Remarks.—The American species agrees very closely in its essential characters with the genotype *C. denticulata*, but is small and less specialized, and in these respects more closely resembles *C. togata*. All the species examined were characterized by the very fine texture of the rather small axial column and strongly reinforced tissue of the wide peripheral zone.

Calostylis parvula, Foerste.

Calostylis parvula, A. F. Foerste, 1917, p. 200, pl. viii. figs. 2 *a–f*, pl. ix. fig. 5.

I have not seen the corals *, but Prof. Foerste (*loc. cit.*) describes them as small *Calostylis*, usually trochoid, generally not more than 25 mm. long, but sometimes as much as 35 mm., with 30 to 35 septa, and having a relatively simple internal structure.

Horizon and Locality.—Upper part of Laurel Limestone (Niagaran), Reinheimer Quarry, New Paris, Ohio.

Syntypes.—The specimens are in Prof. Foerste's collection, but will be presented by him, in due course, to the U.S. National Museum, Washington.

IV. *Helminthidium*, Lindström, 1882.

Diagnosis.—Scolecoid Calostylidæ, typically simple, with a smooth epitheca, wholly trabeculate septa, and in which transverse tissue has almost entirely disappeared.

Genotype.—*Helminthidium mirum*, Lindström, 1882, p. 16. Salopian, Gotland.

Helminthidium differs from *Calostylis* in the fact that the septa are thoroughly degenerate and are entirely represented by confused trabecular tissue. Only one species of *Helminthidium* is known.

Helminthidium mirum, Lindström. (Pl. XII. figs. 8–15.)

"A coral from Djupvik, Eksta," G. Lindström, 1870, p. 6, fig. 14. The coral is very briefly described and the figure is poor.

Helminthidium mirum, G. Lindström, 1882, p. 16. Lindström gives here only a short description of the species, but a very clear and concise diagnosis of the genus. There are no figures, but reference is made to the specimen figured in 1870.

Calostylis andersoni, H. A. Nicholson, 1879, p. 195; 1889, p. 307, text-fig. 189 same page. Under this name Nicholson mentions specimens of *Helminthidium mirum* from the Wenlock Limestone, Dudley.

Helminthidium mirum, G. Lindström, 1896, p. 4, pl. i. figs. 1–8. In this paper Lindström gives a good description and excellent figures of the coral, and identifies the Gotland form with "*Calostylis andersoni*" from Dudley, specimens

* Prof. Foerste was not able to send me specimens of this *Calostylis* in time for this revision.

of which had been sent to him by Prof. Nicholson. I am indebted to this account of *Helminthidium mirum* for details concerning its habits which my own material could not supply.

Diagnosis.—The same as for the genus.

Description.—The corallum is vermiform in shape, grows to a considerable length, and is often twisted in a remarkable manner, yet maintains a fairly uniform thickness throughout. Lindström mentions individuals from Gotland 10 cm. long and 10 cm. in diameter, but none of the specimens from Dudley were quite so large. Pl. XII. fig. 15, copied from Lindström, shows a specimen so bent that the proximal and distal parts lie almost parallel to one another. The corals are almost invariably simple, but occasionally lateral buds are present, as in the case of the coral from Dudley here illustrated (Pl. XII. fig. 9). The calice may be convex, flat, or concave. The epitheca is perfectly smooth and glossy, or may be lightly wrinkled by transverse growth-lines. The distal end, according to Lindström, is relatively large and flat, and by means of this broad base the young coral attaches itself to some foreign object, and then secures its mooring more effectually by an expansion of epithecal tissue, as illustrated by Lindström's fig. 3, reproduced here as fig. 14 of Pl. XII.

Internal Structures.—The septa have entirely lost their individuality, and have degenerated into a confused meshwork of trabeculæ which completely fills the interior of the coral. A peripheral deposit of stereome forms a lining to the epitheca and constitutes a narrow stereozone. Transverse tissue is merely represented by a few widely separated tabulæ, but certain stratification of the trabecular elements is to be noticed in longitudinal section.

Horizons and Localities.—According to Lindström *Helminthidium mirum* is common in the "Mergelschiefer" (horizon *c* = Wenlock) of Stora Carlsö and Djupvik in Eksta, and in higher beds (horizon *f* = Ludlow) of Stora and Lilla Carlsö, Klinteberg, and Ryssnäs on Färö. It is also found in the Wenlock Limestone of Dudley and Ironbridge, Shropshire. Lindström mentions that two or three local varieties or mutations occur at Gotland, a larger form 10 cm. long and 10 mm. thick characterizes the "Mergelschiefer" of Stora Carlsö, a smaller form 4 cm. long and 7 mm. thick the higher beds of the same island and of Klinteberg, and a smaller form still (only 2 cm. long and 5 mm. in diameter) the "Mergelschiefer" of Djupvik.

Material.—Riksmuseet, Stockholm; British Museum.

Literature.

Bernard, H. M. 1904. "The Prototheca of the Madreporaria, with Special Reference to the Genera *Calostylis*, Linds., and *Moseleya*, Quelch." Ann. & Mag. Nat. Hist. ser. 7, vol. xiii. pp. 1–33, pl. i.

Duncan, P. M. 1884. "A Revision of the Families and Genera of the Sclerodermic Zoantharia, Ed. & H., or Madreporaria (*M. rugosa* excepted)." Journ. Linnæan Society (Zoology), vol. xviii. pp. 1–204.

Edwards, H. M., & Haime, J. 1850. 'A Monograph of the British Fossil Corals.—Pt. I.' Palæont. Soc. London.

Foerste, A. F. 1906. "The Silurian, Devonian, and Irvine Formations of East Central Kentucky, etc." Kentucky Geological Survey, Bull. 7. Lexington.

——. 1917. 'Notes on Silurian Fossils from Ohio and other Central States.' Ohio Journ. Science, vol. xvii. pp. 187–204, 233–266, pls. viii.–xii.

Frech, F. 1890. "Die Korallenfauna der Trias." Palæontographica, vol. xxxvii. pp. 1–116, pls. i.–xxi.

Gerth, H. 1908. "Beiträge zur Phylogenie der Tubocorallier." Zeitschrift für Induktive Abstammungs und Vererbungslehre, vol. i. pp. 11–68.

Gürich, G. 1908. 'Lietfossilien etc.' Leif. i. Berlin. 8vo.

Kjerulf, T. 1865. 'Veiviser ved Geologiske Excursioner i Christiania Omegn.' Christiania. Pp. i–iv+43. 4to.

Koken, E. 1896. 'Die Leitfossilien.' Leipzig. 8vo.

Lang, W. D. 1917. "Homœomorphy in Fossil Corals." Proc. Geol. Assoc. vol. xxviii. pp. 85–94.

Lindström, G. 1868. "Om trenne nya Öfversiluriska Koraller från Gotland." Ofversigt Kongl. Vetenskaps-Akademiens Forhandlingar, Årg. 25, no. 8, pp. 419–428, pl. vi.

——. 1870. "A Description of the Anthozoa Perforata of Gotland." Kongl. Svenska Vetenskaps-Akademiens Handlinger, Bandet 9 for 1870, no. 6, pp. 1–6, pl.

——. 1882. "Anteckningar om Silurlagren på Carlsöarne." Ofversigt Kongl. Vetenskaps-Akademiens Forhandlingar, Årg. 39, no. 3, pp. 5–30.

——. 1888. "List of the Fossil Faunas of Sweden.—II. Upper Silurian."

——. 1896. "Beschreibung einiger Obersilurischer Korallen aus der Insel Gotland." Bihang. Kongl. Svenska Vetenskaps-Akademiens Handlingar, Band xxi. Afd. iv. no 7, pp. 4–50, pls. i.–viii.

Neumayr, M. 1889. 'Die Stamme des Thierreiches.' Wein und Prag.

Nicholson, H. A. 1879. 'A Manual of Palæontology.' 2nd ed. Edinburgh and London. 8vo.

——. 1887. "On *Hemiphyllum silurense*, Tomes." Geol. Mag. dec. iii. vol. iv. pp. 173–174.

Nicholson, H. A., in H. A. Nicholson & R. Lydekker. 1889. 'A Manual of Palæontology,' vol. i. Edinburgh and London. 8vo.

Nicholson, H. A., & Etheridge, R., jun. 1878. "A Monograph of the Silurian Fossils of the Girvan District in Ayrshire, with Special Reference to those contained in the 'Grey Collection.'" Fasciculus i. pp. ix, 1–136, pls. i.–x.

Robinson, W. I. 1917. "The Relationship of the Tetracoralla to the Hexacoralla." Trans. Connecticut Academy Arts & Sci. vol. xxi. pp. 145–200, pl. i.

Roemer, [C.] F. 1880–1897. 'Lethæa Geognostica,' pt. i., Lethæa palæozoica, 1883, pp. vi, 1–688. Stuttgart.
Smyth, L. B. 1929. "The Structure of *Palæacis*." Scientific Proc. Royal Dublin Soc. vol. xix. (n.s.), pp. 125–138, pls. vi., vii., and viii.
Tomes, R. F. 1887. "On Two Species of Palæozoic *Madreporaria* hitherto not recognized as British." Geol. Mag. dec. iii. vol. iv. pp. 98–100, text-figs 1 & 2 on p. 99.
Weissermel, W. 1927. "Die Umbildung der Rugosen in Hexakorallen." Sitzb. der Preuss. Geol. Landesanst. Heft 2, pp. 1–17, 6 text-figs. (pp. 13 & 14).
Zittel, K. A. von. 1895. 'Grundzüge der Palæontologie (Paläozoologie).' Munchen and Leipzig. 8vo. (And later editions and translations.)

EXPLANATION OF THE PLATES.

Plate X.

Figs. 1–5. *Calostylis roemeri*, sp. n., p. 262.

Fig. 1. Corallum, trochoid form (convex side). Holotype, M.P.G. (Museum of Practical Geology) 48598. × 1·75 approx. Valentian (Upper Llandovery), *Pentamerus*-beds, right bank of Morrell's Wood Brook, 300 yards N.N.E. of Morrellswood Farm, Buildwas, Shropshire.

Fig. 2. Corallum, turbinate form. Paratype, M.P.G. 48600. Nat. size. Same horizon and locality.

Fig. 3. Corallum, turbinate form. Paratype, M.P.G. 48634. Nat. size. Same horizon and locality.

Fig. 4. Corallum, trochoid form. Paratype, M.P.G. 48635. Nat. size. Purple Shales, left bank of Sheinton Brook, 440 yards N.W. of Old Mill, Sheinwood, 1½ miles N.E. of Church, Harley, Shropshire.

Fig. 5. Transverse section. Paratype, M.P.G. $\frac{M}{703}$. Camera lucida drawing, × 2·75 approx. Same horizon and locality as holotype.

Figs. 6–8. *Calostylis togata*, sp. n., p. 263.

Fig. 6. Corallum, cylindrical form. Holotype, M.P.G. 48610. Nat. size. Valentian, Purple Shales, right bank of small stream 60 yards E. of its junction with Hughley Brook and 450 yards S.W. of Hughley Church.

Fig. 7. Corallum, cylindrical form. Paratype, M.P.G. 48611. Nat. size. Same horizon and locality.

Fig. 8. Transverse section. Paratype, M.P.G. $\frac{M}{708}$, cut from specimen 48608. × 2. Valentian, Purple Shales, right bank of another tributary of Hughley Brook 180 yards W. of its junction with the main stream and 720 yards S.W. of Church, Hughley, Shropshire.

Figs. 9–17. *Calostylis aberrans*, sp. n., p. 265.

Fig. 9. Two coralla, one attached to the other by its stalk. Holotype, M.P.G. 48613. × 1·5. Valentian, Purple Shales, left bank of Sheinton Brook, 440 yards N.W. of Old Mill, Sheinwood, 1½ miles N.E. of Church, Harley, Shropshire.

Figs. 10–14. Coralla. Fig. 10, M.P.G. 48633, × 2; fig. 12, M.P.G. 48606, × 1·45, same horizon and locality as holotype of *C. togata.* Fig. 11, M.P.G. 48607, × 1·45, same locality and horizon as holotype of *C. roemeri.* Fig. 13, M.P.G. 46815, × 1·45. Fig. 14, M.P.G. 48612, × 1·45, same horizon and locality as holotype of *C. aberrans.* It may be noted that 48612, fig. 14, is less abnormal in shape and approaches *C. roemeri.*

Figs. 15–17. Three transverse sections. Paratypes, M.P.G. $\frac{M}{709}$. ×2. Valentian, Purple Shales. Same locality as Fig. 8. Fig. 15 below calice; fig. 16 near stalk; fig. 17 through stalk.

Figs. 18–22. *Calostylis lindstromi,* Nicholson & Etheridge, p. 265. Valentian (Upper Llandovery), Penkill, N.E. of Girvan, Ayrshire. British Museum (Mrs. R. Gray Coll.).

Fig. 18. Corallum. Lectotype, R. 26210. Nat size. Specimen figured by Nicholson and Etheridge, 1878, pl. v. fig. 2.

Fig. 19. Corallum. Paratype, R. 26213. Nat. size.

Fig. 20. Corallum. Paratype, R. 26212. Nat. size.

Figs. 21 & 22. Transverse and longitudinal sections of paratype, R. 26269. × 2.

Fig. 23. *Calostylis roemeri.* Longitudinal section. Drawing ×4 approx. Same horizon and locality as holotype. This equally well illustrates the longitudinal sections of the other small species of *Calostylis* here described.

Fig. 24. *Calostylis denticulata* (Kjerulf), p. 267. Longitudinal section. Brit. Mus. R. 26268 (cut from specimen R. 24158). F. A. Bather Coll. × 3·5 (approx.). Salopian, horizon *c* of Lindström = Wenlock. Back of wood, Snäckgärdet, Gotland.

Plate XI.

Figs. 1–11. *Calostylis denticulata* (Kjerulf), p. 267.

Fig. 1. Corallum. Riksmuseet, Stockholm. Nat. size. Salopian, Vestkinde, Gotland. The specimen illustrates the most typical shape of the species.

Fig. 2. Corallum, showing the downward fold of the epitheca. Riksmuseet, Stockholm. Nat. size. The same horizon and locality.

Fig. 3. Corallum with a foot-like expansion of epitheca round the proximal point (left of figure). Riksmuseet, Stockholm. Nat. size. The same horizon and locality. These specimens were probably determined by Lindström.

Fig. 4. Calice of fig. 2. × 1·8.

Fig. 5. Transverse section B.M. (= British Museum) R. 26267. × 1·8. Cut from the same specimen as the longitudinal section R. 26268, Pl. X. fig. 24.

Fig. 6. Longitudinal section B.M. R. 26265 (cut from specimen R. 23931). F. A. Bather Coll. × 2. Salopian, Horizon *c* of Lindström = Wenlock. Röfver Liljas Håla, south of Högklint, Gotland.

Fig. 7. Transverse section (R. 26266) of same specimen. × 2·75 (approx.).

Fig. 8. Colony of cylindrical corallites. Riksmuseet, Stockholm. Approximately half natural size (·55). Salopian, horizon *d* of Lindström, Vestkinde, Gotland. Specimen determined by Lindström.

Figs. 9 & 10. Transverse sections of one of the corallites of fig. 8, × 2. Fig. 9 was cut only about 10 mm. higher than fig. 10. Notice the difference in appearances. Fig. 10 is less developed and more generalized.

Fig. 11. Corallum with numerous young individuals attached to or budding from it. Nat. size. Riksmuseet, Stockholm. Salopian, Visby, Gotland. A specimen named by Lindström.

Figs. 12–17. *Calostylis tomesi*, sp. n., p. 269.

Fig. 12. Corallum. Holotype, B.M. R. 18446 (R. F. Tomes Coll.). Nat. size. Salopian, Wenlock Limestone, Wenlock.

Fig. 13. Corallum. Paratype, B.M. R. 26144 (H. Johnson Coll.). Nat. size. Salopian, Wenlock Limestone, Dudley.

Fig. 14. Corallum. Paratype, B.M. R. 2761 (J. E. Gray Coll.). Nat. size. Salopian, Wenlock Limestone, Dudley.

Fig. 15. Calice of same specimen, B.M. (R. 2761). Nat. size.

Fig. 16. Transverse section. Paratype, B.M. R. 26264 (H. Johnson Coll.). × 1·5. Salopian, Wenlock Limestone, Dudley. (Camera lucida drawing.)

Fig. 17. Transverse section. Paratype, B.M. R. 18448 (R. F. Tomes Coll.). × 2. Salopian, Wenlock Limestone, Dudley.

Plate XII.

Figs. 1–7. *Calostylis spongiosa*, Foerste, p. 270. Syntypes, Waco Limestone, Clinton Formation (Niagaran), Middle Silurian, N.E. of Summer Hotel grounds, Irvine, Kentucky. British Museum, R. 26528–R. 26533.

Fig. 1. Corallum. R. 26528. Nat. size.

Fig. 2. Corallum. R. 26529. Nat. size.

Fig. 3. Corallum. R. 26530. Nat. size. Note lateral bud on the side of this cylindrical corallum.

Fig. 4. Corallum. R. 26531, slightly more than twice nat. size. The specimen is corroded and thus displays the internal structure. See p. 261.

Fig. 5. Calice of R. 26528 (fig. 1). × 1·25.

Fig. 6. Transverse section. R. 26532. × 2.

Fig. 7. Longitudinal section. R 26533. × 2. Cut from the same specimen as R. 26532 (fig. 6).

Figs. 8–15. *Helminthidium mirum*, Lindström, p. 272. Salopian. Figs. 8–13, Wenlock Limestone, Dudley; figs. 14 & 15, Gotland.

Fig. 8. Corallum. B.M. R. 2048. Nat. size. H. Johnson Coll.

Fig. 9. Corallum with lateral bud. B.M. R. 26261. × 1·1. Same horizon and locality. H. Johnson Coll.

Fig. 10. Transverse section. B.M. R. 26272. × 2. Same horizon and locality. J. E. Gray Coll.

Figs. 11 & 12. Transverse and longitudinal sections. B.M. R. 26275. × 2. J. E. Gray Coll.

Fig. 13. Longitudinal section. B.M. R. 26273. × 2. Same horizon. J. E. Gray Coll.

Fig. 14. Young individual attached to foreign body (a *Plasmopora*), reproduced from Lindström, 1896, pl. i. fig. 5, but reduced. About 3 times natural size.

Fig. 15. A much-twisted corallum, also from Lindström, pl. i. fig. 3 (reduced). About half natural size. Horizon *c* = Wenlock, Stora, Carlsö.

Figs. 16–19. Cainozoic Perforata, Aporose corals of peculiar shape. See p. 259.

Figs. 16 & 17. *Lobopsammia cariosa* (Goldfuss), Brit. Mus. R. 26306. Side view nearly 1·5, distal view slightly under nat. size. Middle Eocene, Auvers, France.

Figs. 18 & 19. *Endopachys maclurii* (Lea). Brit. Mus. R. 26327. Side view, nearly 1·5, calice slightly under nat. size. Middle Eocene, Alabama, U.S.A.

XXVIII.—*Contributions to a Study of the British Species of* Machilidæ.—II. *A new Species of* Machilis, *Silv.* (Trigoniophthalmus, *Verhff.*). By H. Womersley, A.L.S., F.E.S.

Machilis britannica, sp. n. (Figs. 1–9.)

Length 12 mm. Colour uniformly dark brownish, but showing the usual reflections. Antennæ and cerci apically indistinctly annulated with white.

Eyes slightly longer than wide, ovate, touching medially. Paired ocelli subrotund, placed medially with regard to the eyes. Single ocellus also roundish. Below the eyes and outside of the paired ocelli is a row of sensory setæ or spines similar to, but smaller than, those on the sternites vii. to ix. Maxillary palpi with joints relatively 2 : 2½ : 2½ : 3 : 4 : 3 : 3; lacinia much shorter than galea. Labial palpi as in fig. 2. Mandibles with four blunt teeth. Antennæ three-fourths of body-length, scaled for at least most of their length.

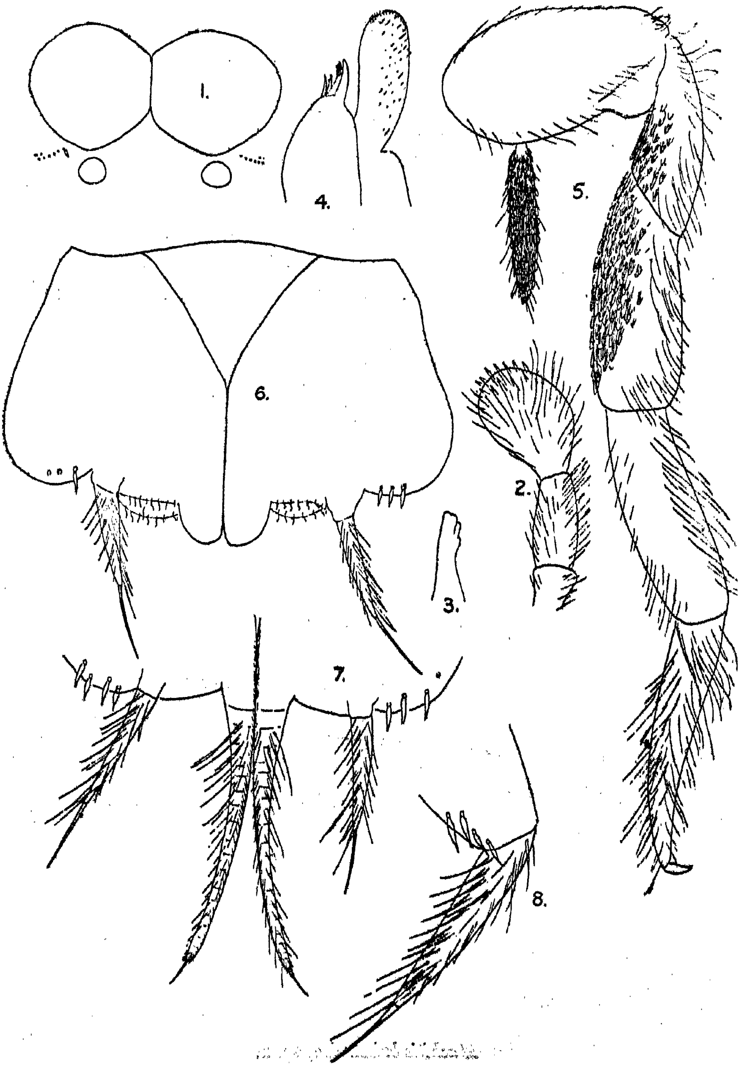
Thorax not unduly arched. Legs moderately robust, with coxal processes on second and third pairs.

Abdomen. Segments ii. to v. with two pairs of exertile vesicles, i., vi., and vii. with one pair. Stylets present on sternites ii. to ix. Apical spine of ninth stylet about half as long as stylet. On the posterior margin of sternites vii. to ix. are a number of spine-like setæ, three on vii., four on viii., and at least four on ix. Subcoxæ of sternite vii. produced into rounded lobes.

Ovipositor short, not reaching tips of ninth subcoxæ, faintly annulated with 18 to 20 joints. On the inside of each appendage are a number of short spines, which at the tip form a group at the base of the longer apical spine (fig. 9).

Median cercus as long as the body, lateral cerci one-third length of median.

Figs. 1–8.



Machilis britannica, sp. n.

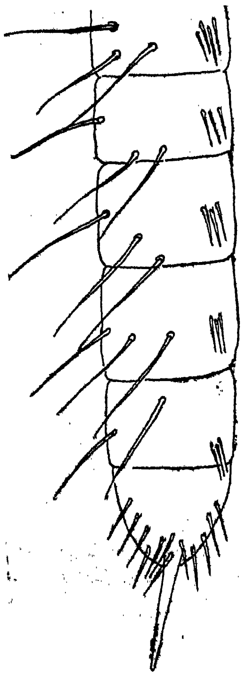
Fig. 1.—Eyes and paired ocelli.
Fig. 2.—Labial palp.
Fig. 3.—Tip of mandible.
Fig. 4.—Maxillary lacinia and galea.
Fig. 5.—Leg of third pair, showing partial scaling.
Fig. 6.—Sternite vii.
Fig. 7.—Sternite viii.
Fig. 8.—Tip of sternite ix. with stylet.

Locality. Berry Head, Brixham, Devon, in moss on stones near the coast, May 1929; a single specimen.

Type-slides (two) of dissections in my collection.

This species comes very close to *Machilis alternata*, Silv., from which it differs in the shape of the paired ocelli and in the presence of sensory spines on sternites vii. to ix. As only the female sex was found, there is, perhaps, some doubt about placing it in Silvestri's genus *Machilis*, which he defined chiefly on male characters. Verhoeff, however, has placed

Fig. 9.



Machilis britannica, sp. n.

Distal joints of hind pair of appendages of ovipositor.

alternata, Silv., in a new genus *Trigoniophthalmus* of his subfamily Machilinæ chiefly on female characteristics. The species herein described can therefore be definitely referred to this same genus. I am of the opinion, however, that it is more practicable to retain Silvestri's wider conception of the genus *Machilis* rather than Verhoeff's subdivision.

REFERENCES.

SILVESTRI, F. 1904. "Nuovi Generi e Specie di Machilidæ." 'Redia,' pp. 1-9.

VERHOEFF, W. H. 1910. "Ueber Felsenspringer, Machiloidea. 4 Aufsatz. Systematik und Orthomorphose." Zool. Anz. xxxvi. pp. 425-438.

Sunny Meads, West Town, Som.,
27th October, 1929.

XXIX.—*Oxford University Greenland Expedition*, 1928.—Ichneumonidæ *collected by Major R. W. G. Hingston on the Oxford University Expedition to Greenland*, 1928. By A. ROMAN (Stockholm).

THE Ichneumonids of the Oxford Expedition *, kindly sent me for determination by Prof. Poulton, are a small series, comprising only 13 species represented by 25 specimens, to which I have ventured to add two more from the Stockholm Museum because of their geographical or synonymic interest. The Greenland Ichneumonids have formed the subject of more publications than those of any other arctic country, the most recent list being that of K. L. Henriksen and W. Lundbeck, "Grönlands Landarthropoder," from 'Meddelelser om Grönland,' xxii. 1917. Nevertheless, every fresh collection continues to provide novelties for science, or, at least, for additions to the Greenland list. This follows from the considerably extended coast-line, with many favourable valleys, as well as from the haphazard way in which these insects have always been collected. The larger species may be netted like butterflies, but are far less conspicuous, while the smaller ones are mostly taken among the mass of insects obtained by general sweeping, but are very apt to disappear as soon as the net is opened. Thus it is evident that in the collections made by most naturalists, with no special interest in parasitic Hymenoptera, these insects will be very poorly represented, and this result not only holds true for the arctic region as much as for any other, but is liable to be intensified by the miserable weather so often encountered by travellers who, perhaps, have no other opportunity of visiting the country.

* [An account of the Expedition, with a full description of the localities visited, is given by Dr. T. G. Longstaff, M.D., in 'The Geographical Journal,' vol. lxxiv. no. i., July 1929, p. 61.—E. B. POULTON.]

Dr. Ch. Ferrière, of the British Museum, had already gone through the collection and named the genera and some of the species. Where my determinations differ from his I have added a second label indicating the conclusion at which I have arrived.

Cratichneumon aurivillii, Roman, 1916.—Kugssuk (30 ft.), July 12; 1 ♀ on heath.

First mistaken for the arctic American *Ichn. laricæ*, Curt., this species seems to be the least rare of the subfamily Ichneumoninæ in Greenland, but the ♂ is nevertheless still unknown. The tip of the abdomen is sometimes red, but this character is not constant. This species has never been found in Europe, and I suggest that it has been derived from America. Greenland is well known to be the meeting-place of both eastern and western arctic faunas.

C. ?erythromelas, McLachl., 1878 (*Ichneumon*).—Kugssuk as above, July 20; 1 ♀ on willow-scrub.

This species was described from the American side of the Kennedy and Robeson Channel, between N.W. Greenland and Grinnel- or Grantland. The description is imperfect, but fits the specimen fairly well. Unfortunately both antennæ are broken off near the base, but the remaining part is entirely black and first flagellar joint hardly longer than it is wide. The post-petiole has its central part slightly elevated, rugulose; the punctuation of mesonotum is coarser than that of the shining scutellum; the hind coxæ have a very small dark scopula beneath. There is more red colour on the head and less on mesonotum and legs than in the description, but this is probably a variable feature, as in many other northern species. According to the description the head should be quite black, but the mandibles, clypeus, spots at frontal orbits, a spot just in front of anterior ocellus, and a line on temporal orbits are red. Of the mesonotum only the central third, not reaching the pronotum, is red, and all femora are mainly black. The tibiæ of *erythromelas* are described as shining black, except for the extreme tips, but in the present specimen the hind tibiæ are red, with about the apical half black. If no slip has occurred in the description, the tibial colour is sufficiently distinct to place this specimen under another species. *Erythromelas* is a small species of 6·0 mm. in length, the Greenland specimen measuring about 5·5 mm.

Cryptus arcticus, Schiödte, 1857.—Kugssuk, June 19–24; 4 ♀, all hunting on the heath.

Size rather variable, 9–13 mm.; pubescence black as in the European *C. cyanator*; easily recognized by the long, somewhat convex cheeks and by the darkish wings. Quite different from all European species, and probably of American origin.

[It is convenient to add a few words on the affinities of *C. fabricii*, Schiödte, although not represented in the collection. It is very nearly allied to the common European *C. laborator*, Thbg. (*fulvipes*, Kriechb.), and I cannot detect any difference between the ♂♂. In the ♀, however, the antennæ are constantly longer and thinner. The fourth flagellar joint is fully three times longer than it is wide, in *laborator* little more than twice. In my opinion *fabricii* ought to be considered as a race of *laborator*.]

Phygadeuon sp.—Matuola (2000 ft.), July 3; 1 ♂ in willow-scrub.

A slender specimen of 4·5 mm. in length, with head moderately narrowed behind the eyes, no teeth or granules on clypeus, and with front, central third of mesonotum, and second abdominal tergite alutaceous. Abdomen black, third tergite with a large basal semicircular spot red. Wings hyaline, with broad blackish stigma, emitting radius from the centre. Of this vast genus single ♂♂ are difficult to locate, and ought not to be named as new species unless they show very marked characters.

Gelis terebrator, Ratz., 1848—Matuola as above, July 7; 1 ♀ under stone.

A typical specimen. Already known from Greenland, the ♂ with abbreviated wings.

Atractodes aterrimus, Holmg., 1872.—Matuola, July 1; 1 ♂ on fox excrement.

The strong sculpture of the thorax sides has, in my experience, only one equivalent among European species, viz., *A. alpinus*, Först., which is, however, a little larger, with 24-jointed flagellum in the ♂, central red on the abdomen, and a closed areolet. This ♂ has an 18-jointed flagellum like all specimens previously investigated.

Plectiscus arcticus, sp. n.—Matuola, July 17; 2 ♀ in willow-scrub.

Species *P. grossepunctato*, Strobl., e Styria descripto proxima, cui notis plurimis et præsertim antennis tenuibus 21-articulatis, abdomine postice ab angulis apicalibus segmenti 2. conspicue parcius punctato terebraque vix exserta simillima. Differt tamen capite pone oculos parum—etsi os versus fortius—angustato sulco genali nullo, genis mandibularum basi saltem duplo longioribus, magnitudine minore, pictura rufa abdominis angustiore et obscuriore, incisura enim 2. sola latius rufescente. Long. circ. 3·5 mm.

This may be Lundbeck's *P. luridus*, and is evidently an intermediate form linking *Plectiscus* with *Pantisarthrus*, Först., to which *luridus* belongs. From this genus it differs by the first flagellar joint being distinctly longer than the second, by the absence of a median longitudinal carina in the sloping hind area of the propodeum, and by the evidently normal oblique areolet. If the first two cephalic characters of the above description had not been notably different, I should have placed the present specimen as an arctic variety of *grossepunctatus*, Str., a species found in forest-clad mountain gorges of the Alps. From *P. hyperboreus*, Holmg., which name Dr. Ferrière had proposed, the specimens differ in the narrow petiole of abdomen and the shorter terebra.

Orthocentrus repentinus, Holmg., 1856.—Matuola, July 16; 1 ♀ in willow-scrub.

This is the first true *Orthocentrus* found in Greenland, and corresponds well with the type except for the hind coxæ and femora, which are as dark as in the five typical Lapland ♂ ♂. Thomson only described the ♂ (from southernmost Sweden), but mentions a yellow spot on each side of the vertex, which is unlike the types.

Stenomacrus sp.*—Kugssuk, July 9; 2 ♀, apparently conspecific, of this difficult genus. They run down to *S. affinis*, Zett., var. *morionellus*, Holmgr., in Schmiedeknecht's key to the genus ('Opuscula Ichneumonologica,' fasc. xlii. p. 3292, 1926).

Regarding these specimens Dr. Roman writes "may be the ? *callidulus* of Lundbeck and even of Holmgr., but suit

* [These two specimens were studied by Dr. J. Waterston and Mr. Ferrière, who sent them to Dr. Roman independently of the rest of the Greenland Ichneumonidæ.—E. B. P.]

better still *morionellus* Holmgr." (The references quoted will be found in 'Meddelelser om Grønland,' p. 532; Kjøbenhavn, 1918.)

Bauchus monileatus, Gr., 1829.—Kugssuk, July 20 1 ♀, July 22 1 ♀, 4 ♂; both sexes visiting *Archangelica officinalis* (many more ♂ ♂ were taken, but were not included in the collection sent to me).

This seems to be the commonest of larger Ichneumonids in W. Greenland, although rare in N. Europe. From Iceland Ruthe described the ♂ as *palpalis*, but Morley, who has seen Ruthe's two specimens in the British Museum, stated in 1915 that "the type" was a ♀ of *B. variegator*, F. (*compressus*, F.). In 1928 I also saw these specimens—a ♀ labelled as type and a ♂,—but made no note about them, probably thinking the identity with *monileatus* to be conclusive. If Morley had compared Ruthe's description he would have gained the same impression, for Ruthe clearly mentions the remarkable palpi. The type-label is no doubt wrongly placed. It is also highly doubtful whether *B. variegator* can withstand the foggy climate of Iceland, for in Sweden it has only been found in the extreme south, frequenting the dry and hot sand-stretches of Scania.

Homotropus elegans nigritarsus (Gr., 1829).—Matuola, July 20, 22; 2 ♀ in willow-scrub.

This dark form was declared by Strobl (1903) to be a distinct species, in which Pfaukuch (1910) gave him a half-hearted support. Morley (1914) took Thomson's view of the question. Our knowledge of the biology of these forms being decidedly scanty, I have followed the same course, but do not use Morley's generic name *Homocidus*, because I think it superfluous.

Mesoleius groenlandicus, sp. n.—Matuola, July 22; 3 ♂, visiting *Archangelica officinalis*.

♂. Niger, puncto scapi subtus, clypeo, mandibulis præter dentes, palpis articulo basali excepto, callo pronoti, tegulis et radice alari, limbis lateralibus et apicalibus segmentorum 3.–7. anguste, his sæpe imperfecte, plica ventrali tota apiceque trochanterum anteriorum, flavis; femoribus, tibiis et tarsis rufis, femoribus basi, i. tantum subtus, ii. et iii. plerumque ultra medium nigris, tarsis posterioribus apice calcaribusque omnibus infuscatis. Alæ hyalinæ stigmate et costa flavescentibus, nervis ceteris fuscis. Long. circ. 7, ala antica circ. 6 mm.

Caput latitudine thoracis, pone oculos modice angustatum, vertice, fronte et facie alutaceis, temporibus et genis magis, clypeo distincte, nitidis, hoc medio tumido marginem apicalem tegente, genis basi mandibulari saltem dimidio brevioribus, linea postocellari illa ocelloculari paullo longiore. Antennæ subsetaceæ corpore vix breviores, flagello 32-articulato (in 2 individuis) articulo 1. scapo, pedicello annelloque unitis vix $1\frac{1}{3} \times$ longiore quam articuli 2 sequentes uniti aperte breviore.—Thorax subcompressus altitudine saltem dimidio longior, mesonoto sat elevato nitidulo notaulis antice obsolete impressis, mesopleuris crasse alutaceis speculo polito; segm. medianum subcoriaceum postice non angulatum, ar. antica distincta a postica non separata, hac rotundata medium non attingente.—Abdomen depressum latitudine maxima (= lat. thoracis) in segmento 4. sita; segm. 1. sensim dilatatum latitudine apicali 1·5–1·8 × longius, alutaceum, fovea basali apice aperta, carinis dorsalibus obsoletis sulco vago angusto separatis; segm. 2. subtransversum alutaceum, thyridiis transversim punctiformibus distinctis, spiraculis vix supra marginem in triente anteriore sitis, segmentis reliquis sensim brevioribus et lævioribus; venter segmentis 2.–4. utrinque macula elongata, cornea, nigra instructis, valvulis genitalibus obtuse acuminatis.—Pedes graciles, femoribus iii. intermediis circ. 1·3 ×, latitudine sua fere 6 × longioribus, tibiis haud spinulosis apice leviter recurvis, tarsis iii. tibiæ æquilongis, articulo 5. 4° longiore, 3° breviore, unguiculis gracilibus pulvillum superantibus.—Alæ abdomen vix superantes, radio paullo ante medium stigmatis egrediente abscissa 2. recta, fenestra externa lata puncto corneo divisa, angulo infero discoidali obtuso, nervulo interstitiali; posticæ nervello antefurcali inferne fracto, hamulis 8.

Mr. K. Henriksen, of the Copenhagen Museum, has had the kindness to compare this species with another doubtfully placed under *Mesoleius* from E. Greenland, and found it to be widely different. To judge from the mesonotal sculpture described and drawn in his letter to me, the Copenhagen species may be a *Syndipnus.* The present species runs in Schmiedeknecht's key to couplet 252, and must be more or less like *M. coriaceus*, Holmg., and *æquabilis*, Holmg. (both only known as ♀♀), but the dark base of the femora is different from these. The Stockholm Museum possesses the single type of *coriaceus*, with sculpture on mesopleura and basal half of abdomen deeply matt, and area postica of the propodeum angular. Of *æquabilis* the Museum unfortunately has no specimen, so that the difference is less certain. As, however, the three specimens at hand show little variability, I thought it expedient to describe the species as new, at any rate until the ♀ is forthcoming.

Holocremna extrema, Holmg., 1872.—Kugssuk, July 11; 1 ♀, probing spider's web.

The "probing" mentioned on the label must have been due to the efforts to escape from the web, for the present genus is known to parasitize sawflies. This species in size and colour is very like my *H. obscura* from S. Sweden, a probable parasite of *Cephaleia*, but there are good specific differences. The antennæ of *extrema* are slender, with inconspicuous pubescence and postannellus a little longer than scape + pedicellus (*obscura*, on the contrary, thicker, with shaggy pubescence, postannellus a little shorter than scape + pedicellus); costæ of propodeum are almost complete, only the areola open behind (*obscura* with costæ incomplete, costula and sides of areola more or less, costa lateralis at least basally, obsolete); spiracles of second abdominal tergite touching the side-margin, sternites 1 and 2 pale, at most darkened posteriorly (in *obscura* these spiracles situated their own diameter above the side-margin, whole venter blackish); hind femora slender, length about six times greater than width, widest part well before the middle, all tibiæ with whitish base (in *obscura* the hind femora thicker, length 4½ times greater than width, more parallel-sided, tibiæ red at base); stigma of wing centrally translucent brown, areolet longly petiolate (in *obscura* stigma black, areolet shortly petiolate).

Length of ♀ 8·5–9 mm.

[*Anilasta pectinata*, Thoms., 1887.

Syn. *Limneria deichmanni*, Nielsen, 1907.
Astiphromma deichmanni, Lundbeck, 1917.

Nathorst Exp. to E. Greenland, 1899: Little Pendulum Island, July 6; 1 ♀ from larva of *Dasychira groenlandica*. Emerged July 12.

Already, in my paper of 1916, I suspected Nielsen's *Limneria* to be an *Anilasta*, but that it should be already known from countries well outside the arctic region was rather unexpected. It is the largest known species of the genus, and the present specimen is of maximum size (10·5 mm.). I have compared it with a Swedish ♂ of 8·5 mm. in my collection, and find the rough mesopleura with no shining speculum, the short rounded propodeum with large oval spiracles, and the areola laterally and apically incomplete, the colour of the legs—hind tarsi, however, of the ♂ totally, of the ♀ apically black,—the short fifth tarsal joint and the long teeth of the claws to be precisely the same in both.

Habermehl, in 1922, records ♂ ♀ from S. Germany, the ♀ bred from *Dasychira fascelina*; so this genus seems to be the special host of *A. pectinata*. Lundbeck gives no reason for his use of a generic name belonging to the essentially hyperparasitic tribe Mesochorini.]

Porizon (Barycnemis) claviventris, Gr., 1829.—Matuola, July 10; 1 ♀ under stone.

This species I have in earlier papers named *læviceps*, Thoms., the surface of the head being polished; but after seeing specimens from different countries I feel sure it must be Gravenhorst's species. If *læviceps*, Thoms., is distinct, it is unknown to me. The first Greenland specimens of *claviventris* were reported in 1916 by myself from Ny Herrnhut, not far from Godthaab.

XXX.—*A Review of the* Asaphidæ.—Part I. By F. R. Cowper Reed, Sc.D., F.G.S.

Introductory Remarks.

Since the publication of Salter's monograph on British Trilobites (1865–67) much has been written on the Asaphidæ, but there is still considerable difference of opinion as to the limits and comprehensiveness of the family, and the value and relations of many of the genera and subgenera are also matters of dispute. As a preliminary to the consideration of existing views on the subject, it will be useful to give Salter's list of genera and subgenera in the family (1). By him *Asaphus* was divided into the following subgenera:—*Ptychopyge*, *Basilicus*, *Megalaspis*, *Isotelus*, *Cryptonymus*, *Symphysurus*, *Brachyaspis*, and *Nileus*; and the following genera were also included in the family:—*Stygina*, *Psilocephalus*, *Ogygia*, *Barrandia* (with its subgenus *Homalopteon*), and *Illænus* (with its subgenera *Octillænus*, *Panderia*, *Dysplanus*, *Ectillænus*, *Hydrolænus*, *Illænopsis*, and *Bumastus*). A large number of new genera and subgenera have been established and ascribed to the Asaphidæ from time to time since Salter's work was published, as the following list illustrates, but many of them have now been removed to other and in some cases new families. The Asaphidæ themselves are now generally recognized to be divisible into two subfamilies. But there has been considerable diversity of opinion with regard to the genera to be allowed,

and even the well-established generic names have been used in many different ways. It will be convenient in the first place to give a list of all the generic names, and subsequently to consider which of them can be admitted as members of the family.

Alphabetical List of Genera and Subgenera.

Asaphelina, Bergeron, 1893 (*Asaphelina miqueli*, Berg.).
Asaphellus, Callaway, 1877 (*Asaphus homfrayi*, Salter).
Asaphiscus, Meek, 1873 (*Asaphiscus wheeleri*, Meek).
Asaphopsis, Mansuy, 1920 (*Asaphopsis jacobi*, Mansuy).
Asaphus, Brongniart, 1822 (*Asaphus expansus*, Dalman).
Barrandia, McCoy, 1849 (*Barrandia cordai*, McCoy).
Basilicus, Salter, 1849 (*Asaphus tyrannus*, Murchison).
Bathyurellus, Billings, 1865 (*Bathyurellus abruptus*, Billings).
Bathyuriscus, Meek, 1873 (*Bathyuriscus haydeni*, Meek).
Bathyurus, Billings (*Asaphus ? extans*, Hall).
Bellefontia Ulrich-Walcott, 1924 (*Hemigyraspis collieana*, Raymond).
Blainia, Walcott, 1916 (*Asaphiscus* (*B.*) *elongatus*, Walcott).
Blountia, Walcott, 1916 (*Blountia mimula*, Walcott).
Bolbocephalus, Whitfield, 1890 (*Bolbocephalus seeleyi*, Whitfield).
Brachyaspis, Salter, 1866 (*Isotelus rectifrons*, Portlock).
Bronteopsis, W. Thompson (*Bronteopsis scotica*, Nich. & Eth.).
Cryptonymus, Eichwald, 1825 (*Asaphus expansus*, Dalman).
Dinesus, Etheridge, jun., 1896 (*Dinesus ida*, Etheridge, jun.).
Dolichometopus, Angelin, 1854 (*Dolichometopus suecicus*, Angelin).
Ectenaspis, Raymond, 1920 (*Megalaspis beckeri*, Slocum).
Gerasaphes, Clarke, 1894 (*Gerasaphes ulrichana*, Clarke).
Hanburia, Walcott, 1916 (*Hanburia gloriosa*, Walcott).
Hemigyraspis, Raymond, 1910 (*Asaphus affinis*, McCoy).
Holasaphus, Matthew, 1893 (*Holasaphus centropyge*, Matthew).
Holometopus, Angelin, 1854 (*Holometophus limbatus*, Angelin).
Holteria, Walcott, 1924 (*Ogygia ? problematica*, Walcott).
Homalopteon, Salter, 1865 (*Barrandia* (*Hom.*) *portlocki*, Salter).
Homoglossa, Raymond, 1912 (*Ogygia dilatata panderi*, Schmidt).
Homotelus, Raymond, 1920 (*Homotelus ulrichi*, Raymond).
Housia, Walcott, 1924 (*Dolichometopus varro*, Walcott).
Hyboaspis, Raymond, 1920 (*Hyboaspis shuleri*, Raymond).
Hysterolenus, Möberg, 1898 (*Hysterolenus törnquisti*, Möberg).
Illænopsis, Salter, 1865 (*Illænopsis thomsoni*, Salter).
Illænurus, Hall, 1853 (*Illænurus quadratus*, Hall).
Isoteloides, Raymond, 1910 (*Asaphus canalis*, Whitfield = *I. whitfieldi*, Raymond).
Isotelus, De Kay, 1824 (*Isotelus gigas*, De Kay).
Kingstonia, Walcott, 1924 (*Kingstonia apion*, Walcott).
Leptopilus, Raymond, 1924 (*Leptopilus declivis*, Raymond).
Lloydia, Vogdes, 1889 (*Bathyurus bituberculatus*, Billings).
Maryvillia, Walcott, 1916 (*Maryvillia arion*, Walcott).
Megalaspides, Brögger, 1886 (*Megalaspis dalecarlicus*, Holm).
Megalaspis, Angelin, 1852 (*Megalaspis gigas*, Angelin).
Nileoides, Raymond, 1920 (*Nileus perkinsi*, Raymond).
Nileus, Dalman, 1827 (*Asaphus* (*Nileus*) *armadillo*, Dalman).
Niobe, Angelin, 1852 (*Asaphus frontalis*, Dalman).
Notasaphus, Gregory, 1902 (*Notasaphus ferguseni*, Gregory).

Ogyginus, Raymond, 1912 (*Ogygia corndensis*, Murchison).
Ogygites (= *Ogygia*, Brongniart), Tromelin & Lebesconte, 1876 (*Ogygia desmaresti*, Brongniart).
Ogygiocaris, Angelin, 1878 (*Asaphus dilatatus*, Brünnich-Dalman).
Ogygopsis, Walcott, 1888 (*Ogygia klotzi*, Rominger).
Onchometopus, Schmidt, 1910 (*Onchometopus volborthi*, Schmidt).
Orria, Walcott, 1916 (*Orria elegans*, Walcott).
Petigurus, Raymond, 1913 (*Bathyurus nero*, Billings).
Platypeltis, Callaway, 1874 (*Asaphus* (*Plat.*) *crofti*, Callaway).
Pseudasaphus, Schmidt, 1904 (*Ptychopyge globifrons*, Eichwald).
Psilocephalus, Salter, 1866 (*Psilocephalus innotatus*, Salter).
Ptychocheilus, Novak, 1883 (*Ogygia discreta*, Barrande).
Ptychopyge, Angelin, 1854 (*Asaphus angustifrons*, Dalman).
Rhinaspis, Remelé, 1885 (*Rhinaspis erratica*, Remelé).
Stygina, Salter, 1853 (*Asaphus latifrons*, Portlock).
Symphysurina, Ulrich-Walcott, 1924 (*Symphysurina woosteri*, Ulrich).
Symphysurus, Goldfuss, 1843 (*Asaphus palpebrosus*, Dalman).
Tsinania, Walcott, 1914 (*Tsinania cleora*, Walcott).
Ucebia, Walcott, 1924 (*Ucebia ara*, Walcott).
Vogdesia, Raymond, 1910 (*Isotelus bearsi*, Raymond).
Xenostegium, Walcott, 1924 (*Asaphus goniocercus*, Meek).

If the Illænidæ are not to be separated from the Asaphidæ, or at any rate only regarded as a subfamily or section, as Zittel (1885), Beecher (1897), and Gürich (1908) have maintained, we have to add the following generic or subgeneric names to the above list :—

Illænus, Dalman, 1826 (*Asaphus crassicauda*, Wahlenberg).
Octillænus, Salter, 1866 (*Illænus hisingeri*, Barrande).
Panderia, Volborth, 1863 (*Panderia triquetra*, Volborth).
Dysplanus, Burmeister, 1843 (*Illænus controtus*, Dalman).
Ectillænus, Salter, 1867 (*Illænus perovalis*, Murchison).
Hydrolænus, Salter, 1866 (*Illænus conifrons*, Billings).
? *Illænopsis*, Salter, 1865 (*Illænopsis thomsoni*, Salter).
Thaleops, Conrad, 1843 (*Thaleops ovata*, Conrad).
Bumastus, Murchison, 1839 (*B. barriensis*, Murchison, partim).
Actinolobus, Eichwald, 1860 (*Illænus atavus*, Eichwald).
Illænoides, Weller, 1907 (*Illænoides trilobus*, Weller).
Wossekia, Raymond, 1916 (*Illænus katzeri*, Barrande).
Stenopareia, Holm, 1886 (*Illænus linnarssoni*, Holm).

Illænopsis was regarded by Holm (2, p. 21) and some others as an Asaphid rather than an Illænid, and only the following were considered by Raymond in 1916 (3, pp. 1–23) to be of generic rank in the Illænidæ which is justly separated off as a distinct family :—

Illænus, sens. str.
Bumastus.
Thaleops.
Dysplanus.
Octillænus.
Actinolobus.
Illænoides.
Wossekia.

These were grouped into two subfamilies :—(1) the Illæninæ, comprising *Illænus*, *Thaleops*, *Dysplanus*, *Wossekia*, and

Octillænus; and (2) the Bumastinæ, containing *Bumastus, Actinolobus,* and *Illænoides.*

Warburg (4, p. 97), in criticising Raymond's classification of this family, would add *Stenopareia*, Holm (2, p. 152), as a genus, and states that a number of new genera must be set up to include species which cannot be referred to this or any of those proposed by Raymond, but no new generic or subgeneric names are suggested. The Illænidæ are, however, regarded by this writer as a very homogeneous and well-defined group after the elimination of such genera as *Symphysurus*, *Nileus,* and *Stygina,* and to constitute an independent family, a view with which the present author is in complete agreement. A new genus *Goldillænus* has recently been added to the list of Illænidæ by Schindewolf (5, p. 201) for a form linking this family with the Bronteidæ.

However, as it is generally considered that the Illænidæ constitute a distinct family and cannot be included in the Asaphidæ, we shall not deal with them further in this paper. But, as above mentioned, a large number of the other genera given in the foregoing list of Asaphidæ have also to be removed when this family is strictly limited according to modern ideas.

Literature.

Dealing now with the principal contributions to the study of the Asaphidæ in chronological order since Salter's time, we may note that until the present century the principal work in defining the genera or attempting a classification of the species was effected in Europe, but since then several palæontologists in America have paid special attention to the group, and amongst them Raymond is conspicuous.

One of the most important papers towards the end of last century was that by Brögger (6, p. 58), who in 1882 gave a full description of the species of Asaphidæ occurring in the so-called *Asaphus* stage (Stage 3) of the Christiania province. He recognized two subgenera in the genus *Nileus* (i. e., *Nileus*, sens. str., and *Symphysurus*), but, on the other hand, *Niobe*, *Ptychopyge*, and *Megalaspis* were treated as genera independent of *Asaphus*, Brogn. (emend. Angelin). A full description of the genotype *A. expansus*, Linn., Wahl., was here given.

Zittel (7, p. 606), in 1885, followed Salter in not separating the Asaphidæ from the Illænidæ, the family being therefore made unduly comprehensive, and the following genera were

quoted :—*Ogygia*, *Bronteopsis*, *Barrandia* (subgen. *Barrandia*, sens. str., and *Homalopteon*), *Niobe* (incl. *Ptychocheilus*), *Asaphus* (subgen. *Ptychopyge, Basilicus, Megalaspis, Isotelus, Asaphellus, Cryptonymus, Symphysurus, Brachyaspis*), *Platypeltis, Nileus, Stygina, Psilocephalus, Illænus* (subgen. *Octillænus, Panderia, Dysplanus, Illænus* (sens. str.), *Ectillænus*, ? *Hydrolænus, Illænopsis*), *Illænurus, Æglina.*

Brögger (8), in 1886, in his important paper on the Asaphidæ, in which he classified them by the characters of the hypostome, somewhat modified his earlier views and regarded the following as subgenera of *Asaphus*: (1) *Asaphus*, sens. str., (2) *Isotelus*, and (3) *Ptychopyge*. But *Megalaspis, Niobe,* and *Ogygia* were treated as independent genera, and *Nileus* with its subgenus *Symphysurus* was put in a subfamily Nileidæ.

Vogdes (9, p. 256), in 1893, gave the following as genera of the Asaphidæ :—*Asaphus*, *Ptychopyge*, *Brachyaspis*, *Megalaspis*, *Ogygia*, *Barrandia*, *Niobe*, *Asaphellus*, and *Nileus*.

Brogger (10), in 1896, in his paper on the distribution of the *Euloma–Niobe* fauna, dealt with a large number of genera often attributed to the Asaphidæ, and discussed the position of many of the common and well-known species, disputing some of the usual generic references, a matter to which we shall have occasion to allude subsequently. But he gave no general list of the genera nor did he define the limits of the Asaphidæ.

Beecher (11, p. 192), in 1897, in his "Outlines of a Natural Classification of the Trilobites," included in the Asaphidæ a number of genera which have now been grouped into separate families, or at any rate removed from the Asaphidæ. His list of genera and subgenera comprised the following :—*Asaphus*, *Asaphellus*, *Asaphiscus*, *Barrandia*, *Basilicus*, *Bathyurellus*, *Bathyuriscus*, *Bathyurus*, *Bolbocephalus*, *Brachyaspis*, *Bronteopsis*, *Dolichometopus*, *Gerasaphes*, *Holasaphus*, *Homalopteon*, *Isotelus*, *Megalaspides*, *Megalaspis*, *Niobe*, *Ogygia*, *Ogygiopsis*, *Phillipsinella*, *Platypeltis*, *Ptychopyge*, and *Stygina*. The Illænidæ were regarded as a separate section of the same family, and in this section he put *Illænurus*, Hall, *Nileus*, Dalman, *Symphysurus*, Goldf., and *Psilocephalus*, Salter, as well as *Illænus*, *Æglina*, etc. The inclusion by him of *Phillipsinella* is not difficult to understand, for it is certainly not a member of the Proetidæ and is more allied to *Stygina*.

Gürich (12), in 1908, divided the family Asaphidæ into three subfamilies—Asaphinæ, Nileinæ, and Illæninæ.

In the Asaphinæ he included the genera *Ogygia*, Brongniart, *Asaphus*, Angelin, *Megalaspis*, Angelin, *Basilicus*, Salter, and *Isotelus*, De Kay. In the Nileinæ he only mentions *Nileus*, Dalman, and in the Illæninæ only the two genera *Illænus*, Dalman, and *Bumastus*, Murchison. But it was an important advance to recognize Brögger's earlier contention that *Nileus* should be separated from the rest, and that it was sufficiently distinct to require at any rate a new subfamily to be established.

A complete revision of the Asaphidæ (in a restricted sense) as represented in the Lower Palæozoic beds of the East Baltic provinces was given by Schmidt (13–17) in 1898–1907, and he established one new genus and one new subgenus. Species of the following genera and subgenera were described by him :—*Asaphus* (sens. str.), Brongniart; *Onchometopus*, Schmidt (gen. nov.); *Isotelus*, De Kay; *Niobe*, Angelin; *Ptychopyge*, Angelin (subgen. *Pseudasaphus*, Schmidt (subgen. nov.); *Basilicus*, Salter; *Ptychopyge*, sens. str., Angelin); *Megalaspis*, Angelin; *Ogygia*, Brongniart; *Nileus*, Dalman; *Megalaspides*, Brögger.

This is one of the most important European works of recent date dealing with the characters of the various genera and subgenera, but, as it is concerned with only a limited area and a local series of beds, it does not give a complete list of the members of the Asaphidæ, and consequently many of the well-known genera or subgenera are not mentioned in it.

The next step forwards was made by Raymond in 1910 (18, p. 37), who recognized the value of the facial sutures in any system of grouping the genera in the family. Accordingly, he distinguished two types of facial sutures in the Asaphidæ under the names the Niobiform and the Isoteliform. In the Niobiform the sutures cut the anterior margin in front of the eye and follow round the frontal margin, as in the type-form *Niobe*. In the Isoteliform type the two sutures meet at a point in the middle of the anterior margin on the dorsal surface to which they are limited, as in *Isotelus*, and he made the valuable observation that among the Asaphidæ with forked hypostomes (Asaphinæ) the isoteliform suture prevails (*Asaphus*, *Onchometopus*, *Ptychopyge*, *Isoteloides*, and *Isotelus*), while *Basilicus* is the only member of that group which has the Niobiform suture. On the other hand, those trilobites with an undivided hypostome usually have the Niobiform suture, for it is present in *Ogygia*, *Ptychocheilus* [*Asaphelina*], *Niobe* [*Symphysurus*, *Illænurus*, *Nileus*], *Barrandia*, *Homalopteon*,

and *Platypeltis.* The Isoteliform suture, however, is present in certain genera with a non-furcate hypostome (*Megalaspis, Megalaspides, Asaphellus,* sens. str., and *Ogyginus* (*O. corndensis,* Murch.).

In the same year Raymond (18, p. 61) divided the family into two subfamilies, Ogyginæ and Asaphinæ, and each of these into two sections according as the anterior limb of the facial suture is marginal or intra-marginal. In the Ogyginæ he put the following genera :—

Section 1 *Ogygia, Niobe, Asaphellus, Symphysurus, Nileus, Vogdesia,* and *Illænurus*; Section 2 *Megalaspis, Megalaspides.* In the Asaphinæ Section 1 contains *Basilicus* only, but Section 2 contains *Ptychopyge, Pseudasaphus, Asaphus, Onchometopus, Isotelus,* and *Isoteloides.*

In 1912 (19, p. 111) the same author similarly recognized two main groups or subfamilies characterized respectively by a forked and a simple hypostome, and he classified the genera on morphologic and phylogenetic principles, drawing special attention to the parallelism between the two lines of development in the subfamilies and the consequent difficulty in deciding the generic reference of any species when the hypostome is unknown. The genera in which the hypostome is entire were given by Raymond as follows :—

Ogygopsis, Ogygiocaris, Ogyginus, Asaphelina, Homalopteon, Barrandia, Homoglossa, Ptychocheilus, Niobe (partim), *Hemigyraspis, Asaphellus, Megalaspis, Platypeltis, Symphysurus, Illænurus, Nileus, Vogdesia.*

To these we shall see that we must now add the following, as they possess the critical characters :—*Xenostegium, Symphysurina, Nileoides, Bellefontia.*

The genera in which the hypostome is forked were given as follows :—*Basilicus, Ogygites, Ptychopyge, Pseudasaphus, Megalaspides, Isoteloides, Isotelus, Asaphus, Brachyaspis, Onchometopus, Niobe* (partim). Within the genus *Niobe,* as generally employed, Raymond considered that there was every transitional stage between the two types of hypostome, the earliest form having an entire hypostome. But this view seems to require qualification in the light of recent work. We must also draw special attention to the fact that *Ogygites* must be referred to the other group, because its true genotype is found to possess a non-forked hypostome, as Oehlert, Schmidt (15, p. 58), and Richter (20, p. 231) have maintained (see sequel). We have also to add to Raymond's second group containing those with forked hypostomes the following more recently established genera :—[illegible] and *Homotelus* (see below).

The general course of development in each group was considered by Raymond to be from a strongly segmented to a smooth form, so that, apart from the hypostome, there exist genera and species which, though not closely related, are often very similar in general aspect. From this cause much confusion in the generic reference of species has arisen, but it is often impossible to be certain of the true position of species when we are without certain knowledge of their hypostomes.

It should be here remarked that while Raymond only recognized two main groups based on hypostomal characters, Brögger (8) had previously recognized three, because in certain genera (*Megalaspis* and *Ogygiocaris*) the hypostome is pointed behind instead of being rounded or truncate, and thus possessing a quadrate or subquadrate shape such as we find in typical *Niobe* (*N. insignis*). This third series of genera, at any rate, deserves subordinate rank as a subgroup.

In 1913 Raymond and Walcott (21, p. 718) divided the Asaphidæ into two subfamilies, but called the first one Ogygiocarinæ instead of Ogyginæ, and the second one (as before) Asaphinæ. The first is characterized by the hypostome being rounded or pointed behind, and in this subfamily the following genera were given :—

Ogygiocaris, Ang. (= *Ogygia* (pars) auctt., non Brongn.); *Ogygopsis*, Walcott; *Megalaspis*, Angelin; *Asaphellus*, Callaway; *Hemigyraspis*, Raymond; *Symphysurus*, Goldf.; *Nileus*, Dalman. The second subfamily is characterized by a bifurcated hypostome, and the following genera were mentioned :—*Asaphus*, Brongniart; *Onchometopus*, Schmidt; *Basilicus*, Salter; *Ogygites*, Tromelin & Lebesconte * (= *Ogygia* Brongniart); *Ptychopyge*, Angelin; *Isotelus*, De Kay.

At a later date Raymond (22, p. 258) gave the following key as showing the more important characters in his estimation which separate the various genera of Asaphids occurring in the formations from the Chazy to the Richmond

* Oehlert, Schmidt, and Richter ('Senckenbergiana,' Bd. vi. Heft. 5–6, 1924, pp. 281–288) have pointed out that the true genotype of *Ogygites* is *O. desmaresti*, Brongn. (Hist. Nat. Crust. Foss. 1822, p. 28, pl. iii. fig. 2), and not *O. guettardi*, Brongn., as Raymond stated (Bull. no. 1 Vict. Mem. Mus. (Geol. Surv. Canada) 1913, p. 44), and that *O. desmaresti* has not a forked hypostome, so that *Ogygites* must be transferred to the other subfamily (Ogygiocarinæ of Raymond). The two species are, moreover, not congeneric according to Richter (*op. cit.*), who would regard *O. guettardi* as an *Asaphus*.

in America. Three main groups were recognized as dependent on the character of the border of the pygidium and head-shield:—

A. Depressed *or concave* border *on both shields*.	
a. Surface of shields ribbed.	
1. Free cheeks meeting in front	*Ogygites.*
2. Free cheeks separated in front..........	*Basilicus.*
b. Surface of shields not ribbed.	
1. Axial lobe narrow, prominent	*Isoteloides.*
2. Axial lobe wide, depressed	*Isotelus.*
B. Concave border on pygidium only.	
a. Eyes very large	*Nileus.*
b. Eyes small, but very high..................	*Vogdesia.*
C. No concave border on either shield.	
a. Free cheeks meeting in front	*Onchometopus.*
b. Free cheeks separated in front	*Brachyaspis.*

But this scheme, though useful for purposes of rough discrimination, does not seem to be based on any stable phylogenetic principles, and is largely artificial.

In 1925 Raymond (23, p. 76) included in the subfamily Ogygiocarinæ the genera *Niobe* (pars) and *Xenostegium*, and in 1924–25 (24, p. 34) he added *Bellefontia* and *Hemigyraspis*, while to the subfamily Asaphinæ he attributed the genera *Homotelus*, *Nileoides*, *Ectenaspis*, and *Hyboaspis*.

Classification.

It will have been noted from the preceding references that of late years a large number of the genera recorded in the first list of Asaphidæ given in this paper have now been removed elsewhere. This is due to the recognition that many of them could not be strictly retained in this family, for, as Poulsen (25, p. 322) has remarked, the Asaphidæ really form one of the best-defined trilobite families known, their type of facial sutures meeting in a point before the glabella, from which they are continued across the doublure as a single suture [=sagittal suture], which is unique.

The formation of new families to receive some of these genera regarded at first as Asaphids has proceeded from time to time. Thus, in 1913, Raymond and Walcott (21, p. 717) separated off *Bathyurus*, *Bathyurellus*, *Petigurus*, and *Bathyuriscus* as belonging to the family termed Bathyuridæ, Walcott. But in 1916 Walcott (26, p. 308) transferred *Bathyuriscus* together with *Dolichometopus* and *Housia* into another family, the Corynexochidæ, and Warburg (4, p. 65) adopts this view of the position of *Bathyuriscus*.

The Styginidæ has been established by Raymond (27, p. 283; 23, p. 93) for *Stygina, Holometopus, Bronteopsis,* and *Leptopilus,* and the same author (28, p. 408) has founded the Asaphiscidæ to contain *Asaphiscus, Blountia, Maryvillia, Blainia,* and *Lloydia,* while *Illænurus,* instead of being considered to be a member of Asaphidæ as in 1916, has been put by him in 1924 (24, p. 48) in a subfamily, the Illænurinæ of the Dikelocephalidæ, Miller, together with *Platycolpus* and *Cholopilus.* Walcott (26, p. 404) had previously discussed the characters of the genus and regarded it as the progenitor of *Illænus.*

The family Asaphiscidæ is stated by Raymond (24, p. 17) to differ from the Asaphidæ in "having a variable number of thoracic segments (7–11), in having the glabella always tapering forward, whereas it generally expands forward in the Asaphidæ, and in retaining many primitive characteristics which are lost by most members of the Asaphidæ," such as the facial sutures being always marginal at the front, eye-lines generally present, and the axial lobe being always narrow and well defined. The Bathyuridæ, which are considered by Poulsen (25, p. 323) to be closely related to the Asaphidæ (especially to *Niobe*) and to differ only in having the cephalon surrounded by a narrow wire-like rim (though we are ignorant of the condition of the rostrum and ventral behaviour of the facial sutures), are distinguished from the Asaphiscidæ, according to Raymond (24, p. 18) by having a longer parallel-sided glabella, a fixed number of thoracic segments, and usually larger eyes.

Poulsen (25, p. 321) has established a new family Symphysuridæ, corresponding with Brögger's and Gurich's Nileinæ to contain the genera *Symphysurus* and *Nileus,* and his new genus *Prosymphysurus* (op. cit. p. 279), the latter being regarded as a link between the Symphysuridæ and Dolichometopinæ. The characteristic features are the course of the facial sutures, the absence of a separate rostrum, and the confluent cheeks due to the absence of a median suture. He differs from his predecessors in not considering the family as closely related to the Asaphidæ, but as possibly related to the Cyclopygidæ (=Æglinidæ), for the facial suture of *Cyclopyge* is intra-marginal, and accordingly the rostrum has disappeared, and the general aspect of the dorsal shield is much like that in *Symphysurus* and *Nileus. Prosymphysurus* (25, p. 279, pl. xvii. figs. 15–18) is held by its founder to belong to the same general group as the new genera *Glossopleura,* Poulsen, *Clavaspidella,*

Poulsen, and a multitude of other Cambrian and Ozarkian genera, but it has reached a stage in evolution which indicates an approach towards the *Symphysurus* group. The outwardly similar genus *Symphysurina*, on the other hand, has a median [=sagittal] suture (29, p. 108), and therefore cannot be put in the Symphysuridæ (see sequel). *Psilocephalus* was considered by Brögger (10, pp. 34, 47, 71) to be probably identical with *Symphysurus*, and the genotype *Ps. innotatus*, Salt., was regarded as very similar to *S. incipiens*, Brögg., but Ulrich (29, p. 111) thinks it is more related to *Symphysurina*, and if this is the case it must be placed amongst the Asaphidæ.

The genus *Æglina* [=*Cyclopyge*] has relations with *Symphysurus* and *Nileus* (25, p. 324), but is so peculiar that it has generally a family to itself.

There are several other genera which must be removed from the Asaphidæ. Such is *Asaphopsis*, which Mansuy (30, p. 10) established recently for certain trilobites from Annam which have a pygidium resembling that of *Ptychopyge*, but they possess on each side of it a free marginal spine in prolongation of the fifth segment. The head-shield is unknown, but some isolated thoracic segments have been ascribed to it. Mansuy would refer to this same genus the trilobite from the Ordovician of the Montagne-Noire, Saint Chinian, described by Bergeron as *Dicellocephalus ? villebruni* (31, p. 473), but Walcott (32, p. 353), following Brögger, had previously referred this species to Brögger's genus *Dikelocephalina* (10, p. 16). The only two Indo-Chinese species, *A. jacobi* (30, p. 11, pl. i. figs. 7 *a–f*) and *A. reedi* (30, p. 12, pl. ii. fig. 1), described by Mansuy should therefore probably be placed in the latter genus, and removed to the Dikelocephalidæ.

Bolbocephalus, Whitfield (43, p. 36), appears to be referable to the Bathyuridæ or the Solenopleuridæ (33, p. 81).

Hysterolenus, Möberg (34, p. 318), is doubtfully referred to the Asaphidæ by Stubblefield and Bulman (35, p. 137), but we may strongly doubt the correctness of this view.

Holasaphus, Matthew (36, p. 268) (type, *H. centropyge*, Matth.), is probably a Bathyurid (33, p. 35), though the hypostome much resembles that of *Megalaspis*.

Notasaphus, Gregory (37, p. 115) (type, *N. fergusoni*, Greg.), though considered to be an Asaphid by its founder, must be referred to the Corynexochidæ.

Dinesus, Etheridge, jun. (38, p. 56), though sometimes placed with the Asaphids, seems more allied to *Olenoides*.

Etheridge believed that it was allied to *Lloydia*, one of the Asaphiscidæ.

Hanburia, Walcott (39, p. 225, pl. xxxvi. figs. 3, 4), is doubtfully put by its author with the Asaphidæ, and *Orria*, Walcott (26, p. 379, pl. lxvi. figs. 2, 2 *a*, 3), seems to be a transitional form connecting *Ogygopsis* with *Bathyuriscus*, and may belong to either of the families containing these genera.

The genus *Holteria*, Walcott, was finally (25, p. 91) regarded by its author as more allied to *Olenoides* (40, p. 25) than to any Asaphid.

There is another doubtful Asaphid genus termed *Asaphelina*, Bergeron, having as its genotype *A. miqueli*, Berg. (41, p. 333), which Brögger (10, p. 22) declares is not congeneric with the earlier-described *Asaphelina barroisi*, Mun. Ch. & Berg. (42, p. 339 ; 31, p. 475), the latter being referable to the genus *Dikelocephalina*, Brögger (10, p. 12). Pompecki (44, p. 3) considers that the head-shield figured in 1895 (*op. cit.*) by Bergeron belongs to a *Niobe* or *Asaphellus*. But, as Poulsen (25, p. 322) remarks, some species of *Dicellocephalus* have facial sutures resembling those of the Asaphidæ, which are probably descended from the Dikelocephalidæ.

Hyboaspis, Raymond (23, p. 103), is probably an Illænid rather than an Asaphid, and the same uncertainty prevails with regard to *Illænopsis*, Salter, as above remarked.

Warburg (4, p. 65) does not consider that *Ogygopsis* is appropriately retained in the Asaphidæ, and with regard to *Asaphiscus* states that it differs so much from the true Asaphidæ that it ought not to be referred to this family, though it may have originated from the same stock. But Raymond, as previously mentioned, had already made *Asaphiscus* the type of a separate family. Walcott (26, p. 381), however, had in 1916 maintained that the genus had characters which related it closely to *Ptychoparia*, and in his remarks on the affinities of the genus does not mention *Asaphus* or any member of the family.

Swinnerton (45, p. 260), in his recent remarks on the trilobites, puts down *Ptychoparia* as an Asaphid, and considers it to be the basal type of a separate group of his section Ptychoparina of his suborder Conocoryphida (46, p. 540). He had previously stated (46, p. 543) that "the three families Illænidæ, Asaphidæ, and Bathyuridæ constitute the isopygous section of the Ptychoparian type," the Bathyuridæ being regarded as "an early offshoot of the

ancestral Asaphid stock." Warburg (4, p. 78) holds a slightly different view, stating that "the Styginidæ, the Bronteidæ, and the Illænidæ seem to be related to each other, and perhaps to the Asaphidæ, with which the Bathyuridæ possibly ought to be brought together."

There is as yet no completely satisfactory definition of the family Asaphidæ, but Raymond (19, p. 111) in 1912 stated that it may be "briefly characterised as consisting of opisthoparian trilobites, with large head and abdomen-shields, prominent eyes, eight segments in the thorax, and always with a median vertical suture in the doublure of the cephalon." It is the characters of the cephalon on which most reliance is placed.

Henriksen (47, p. 18), in discussing the segmentation of the Trilobite head, notes that the facial sutures have a very characteristic course in the genera *Asaphus*, *Ogygia*, *Megalaspis*, *Niobe*, and allied forms, the two sutures converging more and more anteriorly on the upper side of the head till they meet in the median line, and "then as an odd sagittal furrow run forwards across the border through the doublure of the proximal border of the hypostome." This so-called "sagittal furrow" is the "median vertical suture in the doublure," stated by Raymond (19, p. 111) to be one of the chief characteristics of the Asaphidæ. There is no rostrum (epistome) present in the Asaphidæ, which makes Henriksen's views of the segmentation of the trilobite head difficult of application to this family, unless we believe with him that the rostrum has been absorbed in the hypostome and is represented in *Asaphus* by the so-called ears of the latter structure. But this explanation of its absence as a separate structure is hard to accept as satisfactory.

Before Poulsen's paper (*op. cit.*) was published the present author had followed Brögger and Gürich in separating from the Asaphidæ the genus *Nileus* (15, p. 63) and its allied genera *Symphysurus* and *Psilocephalus* (according to Brögger) (10, p. 34), together with *Illænopsis* and perhaps *Tsinania* (according to Ulrich) (29, p. 110), because of the absence of a sagittal suture which Raymond (19, p. 111) has chosen as a critical character of members of the family. The doublure in these genera is simple and continuous, owing to the union of the two cheeks below the front of the cranidium into a single piece, and there is no sign of a double origin for this subcranidial band. Raymond, of course, noticed it, but did not apparently attach much

importance to it. Henriksen (47, p. 21), however, says that "if *Nileus* and *Symphysurus* are to be retained in the Asaphids the actual shape of the furrows [=facial sutures] must be interpreted as [having] arisen through [the] disappearance of the sagittal furrow, and thus only a transverse splitting line is retained which runs in a bow round [the] glabella without being pointed anteriorly." Further on (*op. cit.* pp. 21, 22, fig. 18), in discussing the similar doublure in the Æglinidæ, he considers that it likewise only represents the fused movable cheeks, while the rostrum [=epistome] has disappeared. In *Placoparia grandis*, Barr., the rostrum is reduced to a small triangular plate with the sagittal suture starting from its apex and crossing the doublure, and in *Cybele bellatula*, Dalm., the rostrum is only represented by a very narrow median plate longer than wide.

Henriksen further points out that in the Bronteidæ and Illænidæ the rostrum [=epistome] is a broad transverse plate between widely separated convergent transverse sutures which cut it out of the doublure. It is only the Phacopidæ which are like *Nileus* and its allies in having no epistome and no transverse sutures. In the author's opinion, the absence of a sagittal suture seems to be a fundamental and important difference, and we have no phylogenetic or ontogenetic evidence that the sagittal suture has arisen by the median approximation and ultimate coalescence of the pair of transverse sutures on the doublure so as to form a single unpaired sagittal suture, or that its absence is due to the disappearance of this sagittal suture by the median fusion of the two sides of the doublure, or by the absorption of the epistome in the doublure owing to the disappearance of the transverse sutures which are so typically developed in the Illænidæ and Bronteidæ. The existence of a single median [sagittal] suture across the doublure seems to mark off the true Asaphids, and indeed has been given as one of the characters of the family by Raymond (21, p. 718). In *Nileoides* (27, p. 284; 23, p. 97) this suture is present in contradistinction to *Nileus*. But with regard to *Vogdesia* (23, p. 95) the subcranidial surface does not appear to have been described, and the hypostome is unknown, so that the location of this genus is doubtful (see sequel). *Symphysurina* (29, p. 108), as before mentioned, is likewise separable from *Symphysurus* because of its sagittal suture, in spite of its general similarity of appearance.

It may be noted as an additional reason for separating

Nileus and *Symphysurus* from the Asaphidæ that Lindström (48, p. 72) found one type of maculæ on the hypostome of these two genera (and doubtfully of *Ogygia*), and another on that of *Asaphus, Isotelus, Megalaspis, Ptychopyge, Niobe*, and doubtfully of *Megalaspides* and *Barrandia*. The hypostome of *Nileus* (8, p. 64, t. iii. fig. 40) has, indeed, very slight resemblance to that of any of the other accepted Asaphids.

We do not know if *Symphysurus superstes*, Olin (49, p. 64), and *S. bröggeri*, Ruz. (50, p. 10), are true members of the genus, but the latter is said to be most like *S. incipiens*, Brögg., and the former like *Nileus armadillo*, Dalm. There is also a new species of *Nileus* (*N. holoubkowensis*, Ruz.) described by Ruzicka (50, p. 10, pl. ii. figs. 10, 11), which by its much smaller eyes and other characters seems to belong to another genus.

Raymond (53, p. 206) remarks that Walcott (51, p. 43; 52, p. 227) in 1914 proposed the name *Tsinania* for trilobites of the type of *Illænurus canens*, Walcott (52, p. 22) a Chinese species which has a cranidium similar to that of *Symphysurus*, but more nearly hemispherical, and a pygidium which is nearly as long as wide. This latter feature is the most distinguishing one for the genus and is not shared by the American form. *Tsinania cleora*, Walcott (39, p. 227, pl. xxxvi. figs. 9, 9 *a–c*), as shown by Walcott's figures, has the short pygidium of the typical *Symphysurus*.

In the same paper on the Ceratopyge Fauna in Western North America, Raymond further states (53, p. 207) that the other described species of *Tsinania* (*Ts. elongata*, Walc.) is also a *Symphysurus*. Ruzicka (50, p. 10) puts *Symphysurus* as a subgenus of *Nileus*, as did Brögger in 1886.

Poulsen's view (25, p. 321) that the characters of *Symphysurus* and *Nileus* are sufficiently distinct to warrant the establishment of a new family Symphysuridæ has been stated above, and with this the present author is in complete agreement.

If Brögger's (10, pp. 31, 77) view is correct that the genotype of *Platypeltis*, Callaway (71, p. 664), belongs to the genus *Symphysurus*, we must regard the former name as a synonym, which must be dropped, for no other species of *Platypeltis* appears to have been described, except a very doubtful one from Sardinia. But it is more probable (29, p. 111) that the genus *Symphysurina* which is an Asaphid is more allied to *Platypeltis*, if not inseparable from it.

Relations of the Genera.

After the elimination of the above-mentioned genera we are left with the following as members of the Asaphidæ :—

Asaphellus.	*Nileoides.*
Asaphus.	*Niobe.*
Barrandia.	*Ogyginus.*
Basilicus.	*Ogygites.*
Bellefontia.	*Ogygiocaris.*
Brachyaspis.	*Ogygopsis.*
Ectenaspis.	*Onchometopus.*
? *Gerasaphes.*	? *Platypeltis.*
Hemigyraspis.	*Pseudasaphus.*
Homalopteon.	*Ptychocheilus.*
Homoglossa.	*Ptychopyge.*
Homotelus.	*Rhinaspis.*
Isoteloides.	*Symphysurina.*
Isotelus.	? *Vogdesia.*
Megalaspides.	*Xenostegium.*
Megalaspis.	

The above can be grouped into two subfamilies, Asaphinæ and Ogygiocarinæ.

Commencing with the first group, the central type of the genus *Asaphus* (Brongniart) in the Asaphinæ is *A. expansus*, Linn.-Dalman, and Raymond (19, p. 114) says that it is "characterised by its short broad cephalon and pygidium, from which all depressed borders are absent, by the rather prominent glabella which expands towards the front and reaches the anterior margin, the large prominent eyes, the course of the anterior portions of the facial suture which meet in a point in front of the eye, and the short pygidium with narrow well-defined axial lobe and smooth pleural lobes." The fullest description of the specific characters was given by Brögger (6, p. 85) in 1882 and by Schmidt (14, p. 24) in 1901.

The generic name *Cryptonymus*, Eichwald, 1825, has been generally discarded for Brongniart's name *Asaphus*, 1822, which has the priority. The genotype was the same. *Cryptonymus*, however, has been revived by Vogdes and Mitchell for a group or subgenus of *Encrinurus*, but this practice does not commend itself to the present author for reasons which he has elsewhere stated (54, p. 51).

Brögger (10, p. 26), in 1886, gave the following rather unsatisfactory definition of the subgenus *Asaphus*, sens. strictiss.:—" Arten mit relative stärker gewölbter Schale; die losen Wangen des Kopfschildes in der Regel nicht in Hörner ausgezogen; Pleuren am Thorax gerundet mit nach vorn

gewendeter Spitze oder quer abgestutzt; Pygidium glatt, selten deutliche Gliederung der Seitenloben zeigend, mit grossem Umschlag, welcher doch nur in der hinteren Hälfte an der Unterseite der Rachis reicht." But he states that though this definition of the subgenus is not sufficient, yet it serves for most species. He also considers that sharp limits between the subgenera *Asaphus* and *Ptychopyge* cannot be drawn, and much less between *Asaphus* and *Brachyaspis* or *Isotelus*, or between *Ptychopyge* and *Basilicus*.

Schmidt (14, pp. 4–15) quoted with approval the definition of *Asaphus* given by Angelin (55, p. 51), which runs as follows:—"Corpus ovale convexum longitudinaliter trilobum; crusta lævis, impresso punctata vel striolata. Caput breve, subtriangulare, angulis haud elongatis, muticis [except *A. platyurus*, Ang., in which the angles are spined]. Frons obsoleta vix latior, basi utrinque sub 1-loba, apice rotundata. Oculi subconici, distincte reticulati, supra truncati loboque orbitali rotundato præditi, subdistantes versus medium frontis siti. Sutura facialis postice ab oculis basim capitis intus flexa attingit, anticeque frontem anguste circumscribens, apice ipso rotundata cum acumine. Thorax e segmentis 8 conficitur; Rhachis convexa sat lata, pleurarum segmenta sulco longitudinali, lato, extrorsum evanescente canaliculata, apice rotundata, antrorsum imbricata. Abomen capiti respondens, parum convexum, immarginatum; rachis elongata, conica, ante apicem desinens; costæ laterales nullæ [in well-preserved pygidia there are traces of ribs, as in *A. cornutus*, Pand., and *A. ornatus*, Pomp.]; exempla sero decorticata sæpe radius obsoletissimis duplicatis. Limbus scuti inferior latissimus, striis irregularibus, remotiusculus." The hypostome has been described in detail for various species by Brögger (8), and Schmidt (14) has added further to our knowledge. A final satisfactory definition of the genus as now understood must be left till we have considered its development and relations. It is Raymond who has paid most attention to these questions, and in 1912 (19, p. 114) he traced two or more lines of development from *Asaphus*, sens. str. (genotype, *A. expansus*). One line which has a tendency to widen the axial lobe leads to the subgenus *Onchometopus*, Schmidt, in which "the glabella is less prominent [than in *Asaphus*], the axial lobe of the thorax wider, the thoracic segments flatter, the axial lobe of the pygidium less convex and without rings." There is no concave border on either shield and the free cheeks meet in front (Raymond, 27, p. 286). The conjoint facial

sutures are also nearer to the margin than in *Asaphus*. But in 1920 Raymond (27, p. 285) separated off the American species which had been previously attributed to *Onchometopus*, Schmidt, and put them in a new genus *Homotelus* which was regarded as derived from *Isotelus*.

This genus, *Homotelus* (27, p. 285), Raymond, of which the genotype is *H. ulrichi*, Raymond (23, p. 87, pl. vi. figs. 3–5), is stated by its founder to have as essential features an isoteliform glabella and sutures, but an asaphiform lack of concave borders on the shields. But as Raymond states that "concave borders are feebly or sometimes even well developed, indicating that this characteristic is one of suppression and showing readily how a *Homotelus* could have been evolved time after time from various species of *Isotelus*," he does not regard it "in a strict sense as a good genus, but as a convenient term for a number of species showing similar characteristics." It differs from *Onchometopus* in not having the peculiar hooked doublure which Schmidt considered the most important feature. Raymond also points out that *Onchometopus* has the high narrow thoracic axial rings of an *Asaphus*, while *Homotelus* has the broader and flattened rings of *Isotelus*. The pygidium in *Onchometopus* is also generally shorter and more nearly semicircular. *Onchometopus* is thus supposed to have sprung from *Asaphus*, but *Homotelus* from *Isotelus*. *Onchometopus*, Schmidt (14, p. 82, t. x. figs. 9–12), was considered to lead on to *Brachyaspis*, Salter, "in which all traces of the outline of the glabella is lost, the pygidium is evenly convex with the axial lobe showing but faintly, and the anterior portions of the facial sutures are crowded on to the margin." As in *Asaphus*, the eyes are large and prominent, and there is likewise no depressed border to the head-shield or pygidium, both of which are short and wide.

Vogdesia, Raymond (27, p. 292), which was first (18, p. 70, pl. xix. figs. 10–12) proposed as a subgenus of *Nileus* is now generally regarded as one of the Asaphinæ and closely related to *Homotelus* and *Brachyaspis*. Such a conclusion rests on the study of the dorsal surface, in spite of the fact that the hypostome has not been observed, but the subgenus differs from both those mentioned in having a wider axial lobe in the thorax and little or no trace of dorsal furrows on the pygidium. The so-called *Nileus vigilans*, Meek & Worthen, belongs to this genus, but *V. bearsi*, Raymond (18, p. 70), is the genotype.

Another line of development traced by Raymond from *Asaphus* was considered to lead to *Megalaspides*, Brögger,

which has a "narrow axial lobe, expanding glabella, no depressed border on the pygidium, but a narrow one on the front of the cephalon." *Megalaspides* was established as a subgenus of *Megalaspis* by Brögger (8, pp. 38–40), with *M. dalecarlicus*, Holm (56, p. 8, figs. 6–12), as the type, to which also he (10, p. 25) was inclined to refer *Megalaspis heroides*, Brögger (6, p. 82), *M. filacovi*, Mun. Chalm. & Berg. (42, p. 93), and *Asaphus alienus*, Barr. Wiman (57, p. 8), Lamanski (58, p. 150), and Schmidt (17, p. 87) have adopted this name as one of generic rank. The hypostome of the type described by Holm has some characteristic features. Raymond considers that this genus leads by one step to his genus *Isoteloides*, Raymond, 1910 (18, p. 36), of which the type is *I. whitfieldi*, Raymond (18, p. 36, pl. xiv. figs. 1–4) (=*Asaphus canalis*, Whitfield). In this both shields have depressed borders, the form is more elongate, and the glabella is only faintly outlined, though Raymond in another place (59, p. 223) says it is "similar to *Isotelus*, but with narrow axial lobe, a definite glabella, and an *Asaphus*-like hypostome," and again elsewhere (18, p. 67) speaks of a "somewhat definitely defined glabella." Walcott (60, p. 58) adopts the generic name and describes several new species. A doubtful species from Greenland has been described by Poulsen (25, p. 295). From *Isoteloides* Raymond considers *Isotelus*, De Kay, to be directly descended, though in the ontogeny of the genotype of the latter he has described successively a *Basilicus* stage, an "*Ogygites*" stage, and an *Isotelus* stage (22, pp. 247–255). The genus *Isotelus* has "the axial lobe of the thorax wide, and the glabella and axial lobe of the pygidium so ill defined as to merge into the general surface of the head." Both shields have depressed or concave borders. *Homotelus*, described above, is a derivative from *Isotelus*. *Isotelus* is of special interest from being one of the few genera of trilobites in which the appendages are known in more than one species (61, pp. 32–39). Moreover, Ruedemann (62, p. 189) claims that in *Isotelus* as well as in other genera of the Asaphidæ a median eye is present, being represented by a tubercle on the glabella.

The generic name *Isotelus* has been used in such different ways and often in such a wide sense at various times that a new definition of it in its strict application is required. It may be here mentioned that it is believed that sex-differences in shape are noticeable in the species of *Isotelus* from the Richmond Formation in America (63, p. 72), as was thought by Salter (1, p. 127) to be the

case with *Ogygiocaris buchi* from Wales, the narrow form being the male and the broad form the female.

In 1894 Clark (64, p. 710) established a new subgenus of *Asaphus* under the name *Gerasaphes* (type, *G. ulrichana*, sp. n., Utica slate), but Ruedemann (65, p. 60) is rather inclined to unite it with *Isotelus gigas*, De Kay.

Ectenaspis, Raymond (27, p. 292; 23, p. 101), of which *Megalaspis beckeri*, Slocum, is the genotype, is considered by its founder to be a descendant of *Isoteloides*, but its hypostome has not been discovered, so that it is not possible to say definitely that it is not a *Megalaspis*. The chief positive points of difference in the type-species from *Megalaspis* are that the glabella is not definitely outlined and is long, and that the axial lobe of the thorax is wider in proportion to the total width than in any species of the true *Megalaspis*. Only one other species of *Ectenaspis* (*E. homalonotoides*, Walcott) (23, p. 102, pl. iv. figs. 9, 10) has been recognised.

Basilicus, Salter, 1849, is considered by Raymond (19, pp. 62, 115) to be the most primitive genus amongst those with a forked hypostome; "the facial suture is marginal in front, the glabella is strongly outlined and shows glabella furrows." The genal angles are spine-bearing. Salter's (1, p. 146) original definition ran as follows:—"Flattened and expanded forms, with rather broad axis; clavate glabella reaching far up the head, with only obscure lobes, the basal pair most conspicuous; approximate depressed eyes, angular or even pointed tips to the pleuræ; tail with many ribs on axis and limb; facial suture marginal in front [*i. e.*, niobiform]; hypostome [=doublure] entire*; labrum [=hypostome auct.] deeply lobed." Type: *Asaphus tyrannus*, Murchison.

Basilicus, as defined and applied by Schmidt (15, pp. 3, 20–29), does not agree with Salter's definition or with the type of the genus, as Raymond (19, p. 116) pointed out in 1912. In all of Schmidt's species the facial sutures are isoteliform not niobiform, and meet in a point in the middle, whereas, as Raymond (18, p. 37) previously remarked, *Basilicus* is the only member of the Asaphid group with a forked hypostome which does *not* have an isoteliform suture. But Raymond (19, p. 116) was incorrect in putting Schmidt's species (*B. kuckersianus*, *B. kegelensis*, and *B. lawrowi*) in *Ogygites* (in which he (33, p. 43) also included *Asaphus canadensis*, Chapman), for *Ogygites desmaresti*, the true type

* This is a mistake, as the doublure is crossed by a sagittal suture.

of *Ogygites* according to Richter, has a simple unforked hypostome, as previously pointed out, *O. guettardi* not being the type. It seems therefore that we must put these Russian species, which have a forked hypostome and other characters like *Basilicus*, but an isoteliform suture, in another new group or subgenus, for which the name *Pseudobasilicus* may be proposed. *A. nobilis*, Barrande (66, p. 657, tt. 31, 32, 35), as Schmidt remarks, has a similar pygidium, and probably belongs to this group; *A. radiatus* Salt. (1, p. 157, pl. xviii. figs. 1, 3, 4, 5), and *A. laticostatus*, McCoy (1, p. 158, pl. xviii. fig. 6), may also be referred to it on the strength of the pygidial characters. Probably *A. ingens*, Barr., as figured by Olin (49, p. 62, t. ii. figs. 24, 25, t. iii. figs. 1–5) from the Trinucleus shales of Sweden also belongs here.

The final stage in this line of development is considered by Raymond (19, p. 116) to be *Ptychopyge* in which "the eyes are very close to the glabella, the facial sutures far within the border, the glabella short and faintly furrowed, the pleural lobes of the pygidium smooth, and the doublure of the pygidium so broad that it underlies all parts of the pygidium except the axial lobe." Schmidt (15, pp. 1–4, 30–32) puts *Pseudasaphus*, *Basilicus*, and *Ptychopyge*, sens. str., as subgeneric divisions of the genus *Ptychopyge*, but Raymond uses the latter name in the restricted subgeneric sense, as Salter apparently did, taking *P. angustifrons*, Dalm (15, p. 34), sp., as the type. Salter's (1, p. 146) definition was as follows:—"Expanded, ovate, gently convex or flattened, with narrow axis; short urceolate glabella, reaching more than halfway up the head, and lobeless; approximate elevated eyes; subangular tips to pleuræ; tail with moderately long axis and many faint ribs on axis and tail [=pleural lobes]. Facial suture forming a long ogive in front. Hypostome [=doublure] entire. [This is erroneous, as there is a sagittal suture.] Labrum [=hypostome] shortly notched." Salter omitted to remark that the genal angles are pointed and produced, as Angelin notes in his original definition, and it should be observed that the pleuræ end in sharp points instead of rounded or truncated tips as in *Asaphus*, sens. str. Another of the most characteristic features was also not mentioned by Salter, *i.e.*, the great breadth of the doublure of the pygidium. The ribs on the pleural lobes of the pygidium are always single and not double as in *Megalaspis*, to which point Schmidt calls attention, and he also notices that in *Ptychopyge* the inner edge of the doublure of the thoracic [illegible] forms a convex curve, while in *Asaphus* the curve

is always concave. Schmidt's (15, p. 3) definition of the subgenus *Ptychopyge* is therefore more detailed and correct than Salter's and runs as follows: "Körper gestreckt, mässig gewölbt. Kopfschild halbkreisförmig bis dreieckig, mit ausgezogenen Spitzen and den Hinterecken, vorn meist mit deutlich ausgesprochenen Randsaum umgeben. Glabella mässig gewölbt, birnförmig bis oblong, mit oder ohne deutlicher Basallobus. Gesichtslinie in eine längere oder kürzere Spitze (en ogive) ausgezogen. Am Vorderrande des hintern Lappens der festen Wangen, hinter den Augen, an der Grenze der Dorsalfurchen meist eine starke höckerförmige oder gebogene Anschwellung. Hypostoma mit kurzen breiten dreieckigen Gabelenden, die nur $\frac{1}{3}$ bis $\frac{1}{2}$ der ganze Länge ausmachen. Der mittelkörper gross, oblong abgerundet. Der Randsaum breit, die Seitenfurchen tief, nach hinten erweitert. Die Vorderflügel aufrecht, stark nach hinten ausgedehnt. Die Maculæ auf erhabenen Grunde, vertical oder etwas nach hinten und aussen geneigt zur Seitenfurche gestellt. Die Dorsal-furchen des Thorax tief; die Rhachis gewölbt, meist schmal. Die Pleuren schrag abgeschnitten oder in spitzen ausgezogen. Die Diagonalfurchen nicht in lange Spitzen ausgezogen, sondern kahnförmig, stumpfer endend; der Pleurenumschlag am innern Rande spitzwinklig oder stumpf vorspringend. Das Pygidium halbkreisförmig bis parabolisch, mehr oder weniger gewölbt, mit ausgeworfenen oder geneigtem Randsaum bis zu welchem die stärker oder schwächer ausgebildeten Pleurenfalten reichen. Der Umschlag reicht entweder bis zur Rhachis in ihrer ganzen Ausdehnung oder nur bis an ihren hintern Theil."

In the subgenus *Pseudasaphus*, Schmidt (15, pp. 4, 5), Raymond states that the facial sutures meet in a point in front of the glabella on the upper surface and are further within the margin than in *Asaphus* [= *Ogygites*, Raymond + *Asaphus*, Raymond], the glabellar furrows are less distinct, the pygidium shows fewer traces of segmentation, and the doublure of the pygidium becomes very wide. Both shields have depressed concave borders, but, whereas in *Basilicus* the free cheeks are separated in front on the dorsal surface owing to the suture being marginal, in *Pseudasaphus* they meet in front. Schmidt's definition of *Pseudasaphus*, which he considers a subgenus of *Ptychopyge*, is not concisely given, but the genotype is *Ptychopyge globifrons*, Eichwald. Apart from the characters of the pygidium it could well be grouped with the true *Asaphus* species. The want of strong rounded pleuræ on the pygidium of *Pseudasaphus*, the

presence of which Angelin held as characteristic of *Ptychopyge*, the narrower doublure to the pygidium which leaves uncovered a piece alongside the upper part of the axis, the triangular and downwardly bent articulating facet on the anterior angles of the pygidium, and, finally, the form of the hypostome (though it is scarcely distinguishable from that of true *Asaphus* species, except in the position of the maculæ) are its principal points of distinction. *Pseudasaphus* resembles *Ptychopyge* in having the genal angles pointed or produced, a flattened border to the head-shield, an almost vertical anterior wing to the hypostome, sharply pointed ends to the thoracic pleuræ, and a very broad doublure of the pygidium reaching at least to the hinder part of the axis, and these characters justify its inclusion as a subgenus of *Ptychopyge*.

Turning now to the group with entire—that is, non-forked—hypostomes, which comprises the Ogygiocarinæ of Raymond, the development is along more than one line.

As regards *Ogygopsis*, Walcott, 1888 (67, p. 446) (genotype, *Ogygia klotzi*, Rominger (68, p. 530), a revised definition of the genus was given by Walcott (26, p. 375) in 1916, and he observed that the genus recalls *Ogygiocaris*, Angelin, as represented by *O. dilatata*, Brünn., and *O. buchii*, Brongn. It is the earliest representative of this group with entire hypostomes. Walcott (*op. cit.*) stated that the nearest Ordovician species to the genotype of *Ogygopsis* is *Ogygiocaris buchi*, Brongn., and that *Orria*, Walcott (26, p. 380), and *Ogygopsis* suggest a stage of development between *Bathyuriscus* and *Ogygiocaris*.

It was held by Swinnerton, Walcott, and Raymond that the main lines of Asaphid development could be traced back to *Ogygopsis*, the young of which genus strongly resemble *Bathyuriscus*. But Warburg (4, p. 65) doubts if these two genera are closely related, and believes that *Ogygopsis* is not appropriately referred to the Asaphidæ. On the other hand, Raymond (19, p. 116), in 1912, declared that *Ogygopsis* is the oldest of the Asaphids and gave rise to three divergent lines of development. In this genus the primitive features, according to Raymond, consist of a strongly ribbed pygidium, a long glabella, eye-lines, eyes far distant from the glabella, and a marginal facial suture. *Ogygiocaris*, Angelin, of which *Ogygia buchi*, Brongn., is a well-known British representative, is regarded by Raymond (19, p. 116) as a direct descendant. The name *Ogygiocaris* must be substituted for this group in place of *Ogygia* auct., and it has *Asaphus dilatatus*, Dalman, as its genotype;

but this genus has nothing to do with the original *Ogygia*, Brongniart, as Schmidt (15, p. 58) has pointed out, and it must be repeated that *Ogygites* [= *Ogygia*, Brongn. et auctt.] has as its type *O. desmaresti*, Brongn., as described by Tromelin and Lebesconte, and not *O. guettardi*, Brongn., which is an *Asaphus*, as the correct reproduction of the type-specimen shows (69, p. 40). Richter (20, p. 231) has drawn attention to this and has corrected Raymond's erroneous use of the name *Ogygites*. *Ogygites* therefore, being based on the characters of *Ogygia desmaresti*, Brongn., comprises only such species as do not have a forked hypostome, but an entire one, and it is in this corrected sense that the generic term is here used.

Raymond (19, p. 111) considered that the development in the group Ogygiocarinæ arising from *Ogygopsis* is parallel to that seen in the Asaphinæ, but it is clear that there are many gaps in the series as at present known. Of the three lines of development recognised by him, there is one in which the glabella remains long and the head short and wide, leading to *Nileoides*, Raymond (27, p. 284), a genus which is defined by its founder as follows: "Cephalon *Nileus*-like; glabella not outlined; cranidium smooth, gently convex, elongate, not abruptly inflected in front of the eyes. Eyes large, but not so large in proportion to the length of the cephalon as in *Nileus*. Vertical [= sagittal] suture present. Axial lobe of thorax wide." Type, *Nileus* [*Nileoides*] *perkinsi*, Raymond (18, p. 69, pl. xviii. figs. 7, 8). For we must no longer consider *Nileus*, sens. str., as a member of the Asaphidæ, as the author has pointed out already in this paper.

Homoglossa, Raymond (19, p. 117), which has a long glabella with glabellar furrows at the sides, a distinct but smooth axial lobe on the pygidium, and smooth pleural lobes, has as its genotype *Ogygia dilatata*, var. *panderi*, Schmidt (15, p. 59, t. viii. fig. 10), and appears to be near *Platypeltis crofti*, Callaway, which Brögger (10, pp. 31, 47) compared with his *Symphysurus incipiens*, but, as previously remarked, *Symphysurus* is an ally of *Nileus* and without a sagittal suture. It is *Symphysurina*, Ulrich (70, p. 37) (genotype, *S. woosteri*, Ulrich) (29, p. 115, pl. xxi. figs. 1–11), to which this line of development leads, either through or parallel to *Nileoides*. The species *Illænurus eurekensis*, Walcott, and *Asaphus illænoides*, Billings, both fall into the genus *Symphysurina*, as Ulrich (29, p. 108) has pointed out, and not into *Symphysurus* as Brögger and Raymond maintained. Ulrich (29, p. 111) goes on to remark that,

"taking into account the hypostome and the dorsal surface of the trilobite, the relationship of *Symphysurina* to *Platypeltis*, Callaway (71, p. 664), is perhaps as close as to any other established genus. The differences lie in the cephala of the two genera, especially in the course of the facial sutures and consequent distinctions in the forms of the cranidia, free cheeks, and eyes. Judging from the form of the cranidium and the general shape and construction of the cephalon, *Platypeltis* represents a younger stage in the evolution of the asaphid trilobites than is represented by *Symphysurina*." Brögger (6, p. 144; 10, pp. 31, 71) was therefore mistaken in thinking that *Platypeltis* should be included in *Symphysurus*. The genus *Symphysurina*, however, has been made to include rather a miscellaneous series of American species which require resorting. The definition of *Symphysurina* should be strictly limited to the characters shown in the genotype of *S. woosteri*, Ulrich, for it may be doubted if the composite description of the characters of the genus given by Ulrich and quoted by Walcott is satisfactory.

If *Symphysurina woosteri* and *S. spicata* (Ulrich) (29, p. 113), the latter of which has the axis of its pygidium produced into a free point behind forming a mucro, are correctly referred to the same genus as *A. illænoides*, Bill., and other species having entire pygidia, we may compare a parallel mucronate development of the pygidium in *Asaphus nobilis*, var. *caudiculatus*, Born. (72, p. 354), which Richter (20, p. 233) considers identical with *A. delessii*, Dufet (73, p. 188), and also in the genus *Xenostegium*, which was separated by Walcott from *Megalaspis* for a similar feature. We may note the corresponding tendency for mucronation in some species of *Dalmanites*, but in these the terminal spine is a production of the marginal border of the pygidium. Such seems also to be the case in *Symphysurina* ? *entella*, Walcott (29, p. 112).

There are two new American genera *Kingstonia* and *Ucebia*, established by Walcott (60, pp. 58, 60) in 1924, which are said to be closely allied, and the former is stated to resemble *Symphysurina*, *Illænurus*, and *Tsinania*. But they are imperfectly known.

Ulrich (29, p. 111) is of the opinion that *Psilocephalus* is probably related to *Symphysurina*, and that *Platycolpus*, Raymond (33, p. 68) (genotype, *Bathyurus capax*, Billings), which its author puts in the Bathyuridæ, agrees also with it closely in certain respects. Brögger (10, pp. 84, 47, 71),

as above stated, put *Psilocephalus* as a synonym of *Symphysurus*, including the British genotype *Ps. innotatus*, Salt., and *Ps. inflatus*, Salt., but this was before the genus *Symphysurina* was recognised. Poulsen (25, p. 321) does not mention *Psilocephalus* in connection with his new family Symphysuridæ.

In the second line of development which Raymond traces from *Ogygopsis*, the new genus *Ogyginus*, a genus founded on the species *Asaphus corndensis*, Murchison (1, p. 130, pl. xvi.) (put by Salter in the genus *Ogygia* in the group or subgenus *Ptychopyge*), is considered to lead on to *Ptychocheilus*, Novak. The characters of *Ogyginus* are those of the genotype, and no other species have so far been referred to it. Salter distinguished a male form with pointed head (long form) from a female form with rounded head (broad form), as he did in the case of *O. buchi*, Brongn., but whether these differences are due to sex or not is questionable. The facial sutures meet in a very blunt point and are intra-marginal. Salter's description that the facial sutures in front "circle round the glabella" is hardly correct, for a distinct median angulation at their junction is perceptible. *Ogyginus* has the posterior end of the hypostome rounded, with a median projection as in *Ogygiocaris* and *Ogygites*.

Ptychocheilus, Novak (74, p. 31) (genotype, *Ogygia discreta*, Barr.) (75, p. 55, pl. vii. fig. 23), which was founded on the character of its hypostome, is considered by Raymond (19, p. 117) to be intermediate between *Ogyginus* and *Asaphellus*. It has produced spinose genal angles like *Ogyginus*, a similar intra-marginal facial suture, a distinct glabella, a distinct axial lobe on the pygidium and ribs on the pleural lobes of the pygidium. It differs chiefly from *Niobe* in having spined genal angles, as Brögger (10, p. 55) has pointed out. *Niobe*, as Novak (74, p. 31) has demonstrated, has a special type of hypostome (see below), but the genus *Niobe* auctt. is a composite and miscellaneous group of species without homogeneity, so that it needs subdivision, a process which Raymond has begun in the case of American species. In spite of *Niobe* having a non-forked hypostome, Woods (77, p. 324) has put it as a subgenus of *Asaphus*, using the generic name in an unusually wide manner.

With regard to *Asaphellus*, Callaway (71, p. 663) (type, *Asaphus homfrayi*, Salter) (1, p. 165, pl. xxiv. figs. 6–12), its characters have been discussed by Raymond, and he denies the possibility of placing it as a subgenus of *Niobe*.

Matthew (76, p. 232), in describing a supposed Canadian variety of the species, has given a description of its ontogeny, but Raymond (28, p. 429) declares that this Canadian form is a distinct species, and may be identical with *Asaphellus obtectus,* Raymond (28, p. 428, pl. xiii. figs. 14, 18), from Vermont, which he subsequently put in the distinct genus *Bellefontia* (see below). Brögger (8, p. 62; 10, pp. 43, 55) put *Ogygia desiderata,* Barr. (80, t. i. figs. 12–14), and *Niobe menapiensis*, Hicks, and *N. solvensis,* Hicks, in the genus *Asaphellus*, but Raymond has transferred them to his genus *Hemigyraspis* (see below).

The chief distinction of *Asaphellus* from *Niobe* is the possession of pointed genal angles to the head-shield and a hypostome which approaches that of *Megalaspis* (14, p. 99). *Asaphellus*, as Raymond remarks (19, p. 117), has "the intramarginal suture, a glabella so faint as to merge into the general surface of the cranidium, and a smooth pygidium, but retains a narrow axial lobe and genal spines," and he considers it to be a close parallel to *Isotelus*, from which he states it is not always readily distinguishable.

The species *Asaphellus obtectus*, Raymond, as above mentioned, has been removed by Raymond (24, p. 35) into the new genus *Bellefontia*, Ulrich (60, p. 54; 29, pp. 69–73), of which the genotype is *Hemigyraspis collieana*, Raymond (18, p. 41). This genus *Bellefontia* seems to be allied to *Ogyginus* in its cephalic characters and also to *Symphysurina*, from which Ulrich (*op. cit.*) considers it a derivative.

Hemigyraspis was proposed by Raymond (18, p. 41) in 1910 as a subgenus of *Niobe* for forms with "entire hypostoma, smooth undefined glabella, which does not reach to the anterior margin, no glabellar furrows and no neck-ring, facial sutures whose anterior limbs cut the frontal margin in front of the eye (Niobiform), thorax with narrow axial lobe, pygidium semicircular and nearly ribless. Type, *Asaphus affinis*, McCoy, as described by Salter (Mon. Brit. Trilob. 1866, pl. xxiv. figs. 13, 14, p. 164)." "Members of this subgenus are very similar to the species of *Asaphellus*, but the facial sutures are of different types in the two subgenera. *Hemigyraspis* is similar to *Niobe* in many respects, but the glabella is not defined by dorsal furrows, as in that genus; there is no neck-ring; there are spines at the genal angles and the pygidium is nearly smooth." According to Ulrich *Hemigyraspis* may be a subgenus of *Platypeltis*, or perhaps of *Symphysurus* [? *Symphysurina*], but not of *Niobe*, as Raymond held, and it also seems to be a close relative of *Asaphellus*.

Raymond puts *Ogygia desiderata*, Barr., *Niobe menapiensis*,

Hicks, and *N. solvensis*, Hicks, in *Hemigyraspis*, and not in *Asaphellus*, as Brögger did. Subsequently, Ulrich, as above observed, separated off certain species put by Raymond in *Hemigyraspis* to form the new genus *Bellefontia*. But we may note that *H.* [*Ogygia*] *desiderata*, Barr., which was put by Brögger in *Asaphellus*, has a hypostome extraordinarily like that of several species of *Megalaspis*, as, indeed, Brögger (8, pp. 55–62) pointed out. Tromelin and Lebesconte (78, p. 631) considered that this species was allied to *O. desmaresti*, Brongn., the type of *Ogygites*.

Megalaspis was regarded by Raymond in 1912 as a close relative of *Ogygiocaris*, as shown by the furrowed pleuræ on the pygidium, but it is an extremely variable genus as commonly understood, and Walcott (60, p. 60) separated off certain species to form the new genus *Xenostegium*, of which the cranidium, according to Raymond (23, p. 81), does not differ obviously from that of *Hemigyraspis*. But *Xenostegium* was based on possessing a mucronate pygidium, and in the characteristics of the cranidium it "differs from *Megalaspis* in lacking the dorsal furrows, so that the glabella is not delimited, and in having the facial sutures reach the anterior border at the sides instead of meeting at an acute angle on the median line" (23, p. 82). Brögger (8, p. 40) and Schmidt (16, pp. 1–6) have given diagnoses of the characters of *Megalaspis*, from which the following critical features may be gathered:—(1) The facial sutures meet in a more or less elongated median point, so as to form an ogive on the upper surface; (2) the genal angles are produced into long spines; (3) the hypostome is swollen and typically produced behind into a point; (4) the glabella is usually well defined and has a wide preglabellar area; (5) the eyes are mostly small; (6) the thoracic axis is small; (7) the thoracic pleuræ have rounded ends and are curved forwards; (8) the pleuræ on the pygidium are duplicate; (9) the doublure of the pygidium is narrow and hollow.

Rhinaspis was proposed by Remelé (79, p. 1032) for a genus resembling *Megalaspis*, but distinguished by the nasute process or horn on the neck-ring; it has *Rh. erratica*, Remelé, at its genotype and sole representative. Schmidt (16, p. 31) considered this species to be identical with *Megalaspis hyorhina*, H. v. Leucht, and did not admit the subgenus, but later (17, pp. 84, 103) was inclined to agree that the group comprising it and allied species merited subgeneric rank.

The third line of development from *Ogygopsis*, according Raymond (19, p. 118), in which the facial sutures are marginal, has *Homalopteon* intermediate in the matter of segmentation between *Ogygopsis* and *Barrandia*, and *Niobe*

is considered to be "probably descended from the same stem as *Hemigyraspis*, and to stand near the stem from which all the Asaphids with forked hypostomes sprang." The type of hypostome in *Niobe* (80, p. 219, t. i. figs. 19–21) is fairly well marked, though the depth of the posterior emargination and consequent size of the lobes varies amongst the species. But the European species attributed to *Niobe* are rather a heterogeneous collection, and it seems that they want re-examination.

Niobe was defined by its founder, Angelin (55, p. 13), as follows:—"Corpus latiusculum, ovale, trilobum, crusta lævissima striolata et impresso-punctata. Caput sat magnum, semilunatum, late impresso-marginatum, cornigerum muticum. Oculi modici; semilunares, reticulati, supra lobo, rotundato tecti. Sutura facialis postice ab oculo ad marginem basis decurrens, antice subampliato-rotundata, prominentiam frontalem circumscribens. Frons humilis, antrorsum vix latior, apice rotundata, marginem haud attingens. Thorax segmentis 8, latis, longitudinaliter sulcatis, apice rotundatis. Abdomen capiti subæquale, margine lato, depresso; rachis crassiuscula conica, marginem haud attingens; pleuræ costis distinctis, latis aut plane nullis."

In spite of Brögger's researches on the structure and limits of the genus, *Niobe* seems even now to include at least three distinct groups, if we rely on the hypostome for discrimination, for there is the bilobed emarginate type of hypostome found in *N. frontalis*, Dalm., *N. explanata*, Ang., and *N. læviceps*, Dalm.; the quadrate non-emarginate type of *N. insignis*, Linnr., and the pointed *Megalaspis* type of *N. homfrayi*, Salter. Raymond rightly recognised that *Niobe* was not a homogeneous assemblage of species.

Salter (1, p. 143) gave the following diagnosis of the genus:—"Broad oval, depressed; with a distinct broad axis and a scarcely clavate glabella which is slightly 4-lobed. Head-angles obtuse. Eyes approximate. The pleuræ facetted and grooved, not produced into points. Tail broadly margined, of a moderate number of segments. Labrum [=hypostome] with a narrow base and parallel sides, the tip obtusely pointed or slightly emarginate, not forked. Hypostome [=cephalic doublure] (in *N. emarginula*, at least) without a vertical suture." [This statement is erroneous, a sagittal suture being present.] Schmidt (14, pp. 98–103) considered that a precise definition of the characters of the genus was impossible at present, and he restricted its use to the group [illegible] *N. frontalis*, Dalm., *N. læviceps*, Dalm., and *N.* [illegible], Schm.

Homalopteon, Salter, which was recognised by Koken (81, pp. 27, 363) as deserving generic rank, is defined by Salter thus:—"Glabella with complete axal furrows, widely clavate above, more or less distinctly lobed transversely by four transverse furrows. Eyes anterior. Pleuræ with remote fulcrum, grooved, but scarcely facetted. Tail with a distinct short axis of several rings; the sides few-ribbed." The type is *H. portlocki* Salter (83, pl. vii. figs. 1, 2, 6, 7; 1, p. 138, pl. xix. figs. 6–10).

Barrandia, McCoy (sens. str.), of which *B. cordai*, McCoy (82, p. 409; 1, p. 142, pl. xix. fig. 5), is the genotype, is worthy of complete separation generically from *Homalopteon*, which Salter thought was a subgenus of it. The definition of *Barrandia* given by Salter (1866) is as follows:—"Glabella with incomplete axal furrows and no distinct lobes. Eyes subcentral. Pleuræ falcate, with a fulcrum close to the axis, grooved, not facetted. Tail with a short ribless axis and smooth sides, the strong articular furrow only present." The character of the doublure and hypostome are not known, but the caudal fascia occupies almost the whole inferior surface of the pygidium, as in *Ptychopyge*, with which genus the pointed thoracic pleuræ and spined genal angles agree. The facial sutures appear to cut the anterior margin far apart, but probably unite in a niobiform manner on the margin. *Barrandia*, in fact, is allied to *Hemigyraspis*, but simulates *Ptychopyge*, and seems parallel to it.

The generic and subgeneric reference of the British species of the Asaphidæ will be treated on a subsequent occasion, and, finally, a revision of the whole family will be attempted.

Postscript.—Since the foregoing paper was sent to press several of the genera established by Raymond, including *Isoteloides*, *Homotelus*, and *Vogdesia*, have been discussed by Troedsson (84), and new species described from the Ordovician beds of Northern Greenland. A suggestive paper by Opik (85) has also been published dealing chiefly with supposed muscle-scars on the glabella of a species of *Pseudasaphus* (*Ps. tecticaudatus*, Steinh.).

References.

(1) Salter. Mon. Brit. Trilobites (Palæont. Soc.), parts 2 (1865), 3 (1866), 4 (1867), pp. 128–216, pls. xiv.–xxx.

(2) Holm. "Ostbalt. Illænidæ," Mem. Acad. Imper. Sc. St. Petersb. xxxiii. no. 8 (1886).

(3) Raymond. Bull. Mus. Comp. Zool. Harvard, vol. lx. no. 1, 1916, pp. 1–23.

(4) WARBURG. "Trilobites of Leptæna Limestone," Bull. Geol Instit. Upsala, vol. xvii. (1925).

(5) SCHINDEWOLF. 'Senckenbergiana,' Bd. vi. (1924), p. 201.

(6) BRÖGGER. "Die Silur. Etagen 2 and 3, in Kristiania Gebiet, 1882, pp. 58–95, t. 1, etc., and text-figures.

(7) ZITTEL. 'Handbuch der Paleontologie,' Abt. 1, Bd. iii. 1885, pp. 606–612.

(8) BRÖGGER. Hypost. d. Asaphiden, Bihang t.k. Vet.-Akad. Handl. Bd. xi. no. 3, 1886, pp. 1–78, tt. i.–iii.

(9) VOGDES. "Bibliogr. Palæoz. Crustacea," Occasional Papers, Californian Acad. Sc. iv. (1893).

(10) BRÖGGER. "Ueber die Verbreitung der *Euloma*, Niobe Fauna," Nyt Mag. f. Naturvidensk. xxxv. 1896, pp. 164–240.

(11) BEECHER. Amer. Journ. Sc. ser. 4, vol. iii. 1897, p. 192.

(12) GÜRICH. Leitfossilien, Leif. 1, Kambrium und Silur, 1908 (Berlin), pp. 66–68, tt. xxiii., xxiv.

(13) SCHMIDT. Mem. Acad. Imper. Sc. St. Petersb. ser. 8, vol. vi. no. 11 (1898).

(14) ——. *Ibid.* vol. xii. no. 8 (1901).

(15) ——. *Ibid.* vol. xiv. no. 10 (1904).

(16) ——. *Ibid.* vol. xix. no. 10 (1906).

(17) ——. *Ibid.* vol. xx. no. 8 (1907).

(18) RAYMOND. "Notes on Ordovician Trilobites.—II., III., IV.," Ann. Carnegie Mus. vol. vii. no. 1 (1910), pp. 35–80.

(19) ——. Trans. R. Soc. Canada, ser. 3, vol. v. sect. iv. 1912, pp. 111–120, pls. i.–iii.

(20) RICHTER. 'Senckenbergiana,' Bd. vi. Heft. 5–6, 1924, pp. 231–233.

(21) RAYMOND & WALCOTT in Eastman-Zittel's 'Text-book of Palæontology,' vol. i. 2nd ed. 1913, pp. 718, 719.

(22) RAYMOND. Bull. Mus. Comp. Zool. Harvard, vol. lviii. no. 5, 1914.

(23) ——. Bull. Mus. Comp. Zool. Harvard, vol. lxvii. no. 1 (1925).

(24) ——. "New Up. Cambr. and Ordov. Trilobites," Vermont State Geol. 14 Biennial Rep. 1924–25 (reprint).

(25) POULSEN. "Cambr. Ozark. and Canad. Faunas of N.W. Greenland," Medd. om Grönland, Bd. lxx. 1927.

(26) WALCOTT. Smithson. Miscell. Coll. vol. lxiv. no. 5 (1916).

(27) RAYMOND. Bull. Mus. Comp. Zool. Harvard, vol. lxiv. 1920, no. 2.

(28) ——. Proc. Boston Soc. Nat. Hist. vol. xxxvii. (1924).

(29) ULRICH-WALCOTT. Smithson. Miscell. Coll. vol. lxxv. no. 3 (1925).

(30) MANSUY. Mem. Serv. Geol. Indo-Chine, vol. vii. fasc. 1 (1920).

(31) BERGERON. Bull. Soc. Geol. France, ser. 3, vol. xxiii. (1895).

(32) WALCOTT. Smithson. Miscell. Coll. vol. lvii. no. 13 (1914).

(33) RAYMOND. Bull. I. Victoria Mem. Mus. Ottawa, viii. no. 1 (1913).

(34) MÖBERG. Geol. Foren. Stockholm Förhandl. xx. 1, 1898, p. 318, t. xvii. figs. 1–9.

(35) STUBBLEFIELD & BULMAN. Quart. Journ. Geol. Soc. vol. lxxxiii. pt. 1, 1926, p. 137, pl. iv. fig. 8.

(36) MATTHEW. Trans. R. Soc. Canada, ser. 2, vol. i. sect. 4, 1895, p. 268, pl. ii. figs. 4 *a*, *b*.

(37) GREGORY. Proc. R. Soc. Victoria, n. s. vol. xv. pt. 2, 1902, p. 115, pl. xxvi. figs. 11–13.

(38) ETHERIDGE. Proc. R. Soc. Victoria, n. s. vol. viii. 1896, p. 56, pl. i. figs. 1–7.

(39) WALCOTT. Cambr. Geol. & Palæont. iii., Cambr. Trilob. Smithson. Miscell. Coll. vol. lxiv. no. 3 (1916).
(40) MEEK. U.S. Geol. Explor. 40th Parall. Palæont. vol. iv. (1877).
(41) BERGERON. Bull. Soc. Geol. France, ser. 3, vol. xxi. (1893).
(42) ——. Ann. Sc. Geol. xxii. (1889).
(43) WHITFIELD. Bull. Amer. Mus. Nat. Hist. ii. (1890).
(44) POMPECKI. Neues Jahrb. f. Miner. Geol., Jahrg. 1902 (1901), Bd. 1, p. 3.
(45) SWINNERTON. 'Outlines of Palæontology' (London, 1923), p. 260, text-fig.
(46) ——. Geol. Mag. dec. vi. vol. ii. 1915, pp. 540–543.
(47) HENRIKSEN. "Segmentation of the Trilobite Head," Medd. fra Dansk geol. Foren. Bd. 7, 1926, p. 18, fig. 16 (reprint).
(48) LINDSTRÖM. "Visual Organs of the Trilobites," K. Svensk. Vet.-Akad. Handl. Bd. 34, iv. 8, 1901, p. 72.
(49) OLIN. Kongl. Fysiogr. Sällsk. Handl. Bd. 16, no. 3, 1906, p. 64, t. iii. figs. 6–9.
(50) RUZICKA. Bull. Internat. Acad. Sc. Bohème, 1926, p. 10, pl. ii. figs. 10, 11 *a*, *b*.
(51) WALCOTT. Smithson. Misc. Coll. vol. lxiv. no. 1 (1914).
(52) ——. In 'Research in China,' vol. iii. (1913).
(53) RAYMOND. Amer. Journ. Sc. ser. 5, vol. iii. no. 15 (1922).
(54) REED. Geol. Mag. vol. lxv. 1928, pp. 51 *et seq.*
(55) ANGELIN. Palæont. Scand. 1851, p. 51.
(56) HOLM. Bih. k. svensk. Vet.-Akad. Handl. no. 9, 1882, p. 8, figs. 6–12.
(57) WIMAN. Arkiv f. Zool. (Upsala, 1905), Bd. 2, no. 11, p. 8, t. ii. figs. 1–10.
(58) LAMANSKI. Mem. Com. Geol. Russ. n. s. Livr. 20, 1905, pp. 8, 150, t. i. fig. 4.
(59) RAYMOND. 7th Ann. Rep. Vermont State Geol. 1910, p. 223.
(60) WALCOTT. Smithson. Miscell. Coll. vol. lxxv. no. 2 (1924).
(61) RAYMOND. "Appendages etc. of Trilobites," Mem. Connecticut Acad. Arts & Science, vol. viii. 1920, pp. 32–39, text-fig. 9, pl. x. figs. 1, 2.
(62) RUEDEMANN. Bull. 189, New York State Mus. 1916, Art. v.
(63) FOERSTE. Bull. Scient. Lab. Denison Univ. vol. xix. (1919).
(64) CLARKE. "Lower Silur. Trilob. Minnesota," Final Rep. Geol. Nat. Hist. Surv., Minnesota, vol. iii. 1894, p. 710, text-figs. 14–16.
(65) RUEDEMANN. Bull. 49, New York State Mus. 1901, p. 60.
(66) BARRANDE. Syst. Silur. Bohème, i. p. 657.
(67) WALCOTT. Proc. U.S. Nat. Mus. vol. xi. 1888, p. 446.
(68) WOODWARD. Geol. Mag. dec. 4, vol. ix. 1902, p. 530.
(69) OEHLERT. Palæont. Univers. Cent. i. ser. 1, fasc. 1 (Paris) (1903).
(70) ULRICH-WALCOTT. Smithson. Miscell. Coll. vol. lxxv. no. 1 (1924).
(71) CALLAWAY. Quart. Journ. Geol. Soc. vol. xxxiii. 1877, p. 664, pl. xxv. figs. 2, 2 *a*.
(72) BORN. Abh. Senckenb. Nat. Gesell. Bd. 36, 1916, p. 354, t. xxvii. figs. 2 *a*–*c*.
(73) DUFET. Ann. Ecole Norm. Sup. (2) iv. 1875 (Paris), pp. 188, 189, fig. 2.
(74) NOVAK. "Zur Kennt. böhm. Trilob." (Beitr. Palæont. Oesterr. Ung. Bd. 3, 1882), p. 31, t. viii. (1), figs. 1–8.
(75) BARRANDE. Syst. Silur. Bohème, i., Suppl. 1872, p. 55, pl. vii. fig. 23.

(76) MATTHEW. "Rept. Cambrian Rocks of Cape Breton" (Geol. Surv. Canada, 1903), p. 232, pl. xviii. figs. 10 *a–e*.

(77) WOODS. "Palæontology, Invertebrate" (Camb. Biol. Ser.), 6th ed. 1926, p. 324.

(78) TROMELIN et LEBESCONTE. "Essai d'un Catalogue raisonné des fossiles siluriens d. depts. de Maine et Loire, etc." (Assoc. franç. l'avanc. Sc. C. R. Nantes, 1875), pp. 631, 633.

(79) REMELÉ. Zeitschr. deut. geol. Gesell. xxxviii. 1885, p. 1032.

(80) NOVAK. Studien Hypost. böhm. Trilob. no. 2 (Sitzungsber. k. böhm. Gesell. Wiss. 1884).

(81) KOKEN. Leitfossilien (1896), pp. 27, 363.

(82) MCCOY. Ann. & Mag. Nat. Hist. ser. 2, vol. iv. 1849, p. 409.

(83) SALTER. Dec. no. 2, Geol. Surv. Grt. Brit. 1849, pl. vii. figs. 1, 2, 6, 7.

(84) TROEDSSON. "Middle and Upper Ordovician Faunas of Northern Greenland" (Medd. om Grönland, lxxii. 1928), pp. 26–36.

(85) OPIK. "Muskelhaftstellender der Glabella von *Pseudasaphus tecticaudatus*, Steinh.," Sitzungsber. naturf. Gesell. Universität Tartu, Bd. xxxv. (1929).

XXXI.—*A new Species of* Phenacoccus (Coccidæ) *from the Eastern Alps*. By E. ERNEST GREEN, F.E.S., F.Z.S.

Phenacoccus tomlini, sp. n.

Adult female broadly ovate, moderately convex above. Dorsum closely coated with white mealy secretion, which is more thickly concentrated on the medio-longitudinal region; with a complete marginal series of short, stout, waxy tassels, the posterior four slightly longer and stouter. No trace of ovisac observed. Length of denuded insect ranging from 2 to 3 mm.; breadth from 1·5 to 2 mm.; average dimensions 2·35 by 1·75 mm.

Antennæ usually 8-jointed (fig. B); but the terminal joint often shows a more or less complete transverse division (fig. C), which, when complete, constitutes a 9-jointed condition.

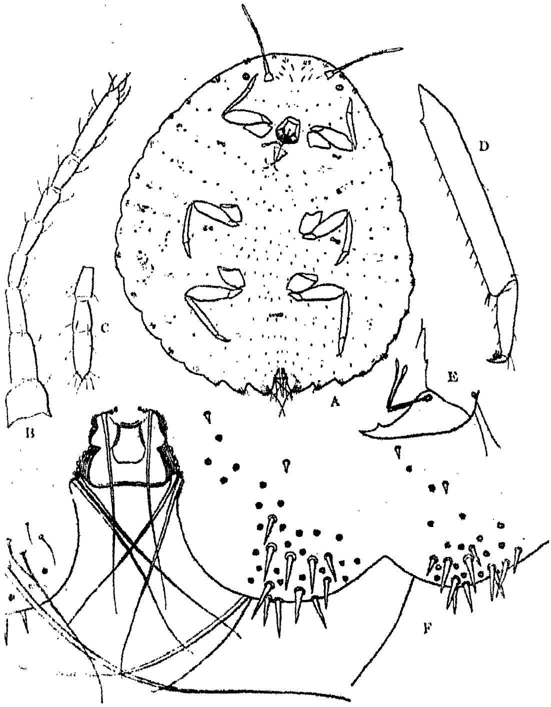
Eyes prominent, bluntly conical.

Labium obscurely dimerous, the length slightly exceeding the breadth at base. Rostral loop short, barely extending beyond apex of labium.

Legs robust; the tibio-tarsal segments together slightly exceeding the femur and trochanter; the tarsus approximately one-third the length of the tibia (fig. D). Hind coxa without translucent pores. Claw (fig. E) strongly falcate, with a prominent denticle on the inner edge near the apex. Tarsal digitules simple; ungual digitules geniculate, with [illegible] apices.

Abdomen with the segmental margins well marked, the posterior three produced into rounded lobes.

With a complete marginal (or submarginal) series of 18 cerarii on each side (see fig. A), all more or less markedly chitinized, each with from 4 to 16 moderately stout, acutely pointed spines, the larger groups being at the posterior



Phenacoccus tomlini, sp. n.

A.—Adult ♀, opt. sec., × 25.
B.—Antenna, × 110.
C.—Terminal joints of antenna, with transverse division, × 110.
D.—Tibia and tarsus of 3rd leg, × 110.
E.—Claw, × 450.
F.—Posterior extremity, × 225.

extremity of the body. A count of ten examples shows the average number of spines on the different cerarii to be as follows (starting from the front) :—6, 5, 9, 5, 4, 6, 9, 7, 6, 6, 7, 7, 7, 8, 8, 9, 10, 12. It will be observed that the third and seventh cerarii always carry a larger number than those immediately preceding and following them, and that the numbers increase regularly from the ninth to the eighteenth.

There are, in addition, many similar but rather smaller spines distributed in transverse series across the dorsum. Anal ring with six longish stout setæ, which are markedly smaller than the caudal setæ (see fig. F). Body-setæ sparse, confined to the ventral surface of the abdomen and frons. A longish supplementary seta springs from beneath each of the last three cerarii. Micropores, of the usual trilocular type, distributed over the derm, but not specially clustered on the cerarii. Disc-pores absent or inconspicuous. Dorsal ostioles not apparent; with a single, oblate, medio-ventral ostiole.

On *Leontodon hispidus*; Solda (Italian Tirol); July 1928. Mr. J. R. le B. Tomlin discovered this interesting species (to which I have appended his name) "in great abundance, at an elevation of 7700 ft., on a rocky spur in a very limited area on the Conifer line." He adds that it is "a very active little insect."

The presence of an occasional division in the terminal segment of the antenna (creating a 9-jointed condition), the large number of cerarial spines and the ungual denticle clearly indicate the association of this species with *Phenacoccus* rather than with *Pseudococcus*.

XXXII.—*Notes on the Breeding-habits and Larval Development of* Ambystoma opacum, *Grav.* By L. A. LANTZ.

THE life-history of *Ambystoma opacum* is already fairly well known in its broad lines through investigations made in the field by several American herpetologists *. The present notes, however, refer to specimens which bred in captivity for two successive years, and the data collected have brought to light some interesting points.

The parent specimens, kindly supplied by Mr. M. K. Brady, were five males and one particularly fine female measuring 112 mm. total length. They were installed in a bog terrarium containing mosses and other moisture-loving plants, and reproducing as nearly as possible the natural habitat of the species.

As is well known, the marbled salamander breeds in the autumn, and the mating season appears to be quite short. In the two cases observed it was restricted to a few days in the first half of October. During this time unusual agitation prevailed in the terrarium after nightfall. The males were steadily pursuing the female, pushing her and rubbing their snouts against her body. They were also seen to chase each other in very much the same manner. Unfortunately nothing further could be observed, the animals being so easily disturbed by light that even switching on a [illegible] electric lamp made them soon retire into their hiding-places. [illegible] procedure of fecundation remains therefore undisclosed.

* [illegible] Copeia, no. 43, 1917, p. 40; no. 70, 1919, p. 51.

On the following days, however, several spermatophores were discovered lying openly on the moss. The spermatophore is a pedestal-shaped, subprismatic, translucent, gelatinous body about 3 mm. high, with a broader basis and a concave top containing the whitish sperm (fig. *a*). At high magnification the sperm looked a tangled mass of spermatozoa intermingled with numerous other much longer and slightly thinner filaments. The spermatozoa are about 75 μ long, thread-like, extremely thin, and bear a narrow pointed head-piece about 6 μ long. At the time the observation took place they were all perfectly inert, and curved into semicircular shape (fig. *b*).

The eggs were laid within two weeks after fecundation took place. The first year, prior to depositing them the female slightly excavated the ground under a creeping-plant in a fairly moist but not saturated part of the terrarium, making it into an oval hollow

a. Spermatophore of *A. opacum*. $\times$ 4.
b. Spermatozoa. $\times$ 1000.

large enough to accommodate her comfortably. Here the eggs were laid, numbering 94, all during the same night. The following year the same cavity was utilized again without alteration; the number of eggs in this instance was 106. The eggs remain perfectly separate from each other, though they are apparently all emitted within a short period of time.

The egg is spherical, 4 to 5 mm. in diameter, and possesses two membranous envelopes, separated by a coat of jelly. A much less viscous medium surrounds the vitelline sphere, which measures 2·5 mm. in diameter.

The female sits on the eggs continuously at first, and intermittently later on. All the embryonic development takes place on land, and the embryo requires about eighty days at a temperature varying between 7° and 12° C. before it is ready to hatch, though larvæ freed from their envelopes twelve to eighteen days earlier are perfectly viable.

The larvæ, however, will never hatch on land, nor will they hatch readily when prematurely immersed in water. The conditions required for normal hatching seem to be for the eggs to remain on land in moderately humid surroundings until mature,

and then to be suddenly immersed in water. In the natural habitat of this species the eggs are laid in the vicinity of ponds, and the female has been observed to move them to higher grounds when the ponds rose. Towards the end of embryonic development the female apparently deserts the eggs, and hatching is provoked by the next flood reaching them.

With regard to the mechanism of hatching itself, it seems probable that a large part is played by sudden swelling of the eggs through rapid absorption of water up to the bursting-point of the membranes. Eggs immersed in water in the earliest stages will develop normally, but the larvæ seem incapable of hatching, or they do so very late, when obvious disintegration of the membranes has taken place.

Considerable latitude exists with regard to the time of hatching, and the larvæ will remain alive inside the egg for a very long time if for some reason hatching is delayed. In one egg kept on land the embryo lived for 207 days; another, which had been immersed in water the day after it had been laid, remained alive four days longer than the previous. If, however, hatching is retarded too long, the larvæ weaken gradually and become incapable of normal development, even if they finally succeed in freeing themselves from their envelopes.

The newly hatched larva is 15 to 19·5 mm. long. The head is very large, the mouth wide. The so-called balancers are about 1·5 mm. long; their function seems to be to support the comparatively heavy head until the fore limbs are able to do this. The three pairs of gills are well developed, 3–4 mm. long, with numerous long filaments. The fore limbs bear three rudimentary or fairly well developed digits. There is a rudiment of the hind limb. The dorsal fin begins on the fore half of the back, and is rather narrow. The upper parts are finely dotted with black, there being an accumulation of pigment in the caudal fin.

The larval development is slow, larval life stretching over a period of 130 to 166 days according to the present observations. The balancers are resorbed more or less rapidly, also the digits and the hind limb do not always grow at the same rate in various individuals. In cases where hatching was retarded the larvæ may have lost the balancers, and possess a rudimentary fourth digit on hatching. Some larvæ have still only hind limb buds six weeks after hatching, their total length being then 24 mm., while other larvæ of the same age and size possess three distinct toes.

The larvæ were fed at first with *Cyclops*, and later on mainly with *Enchytræus*.

According to unpublished field-observations made by Mr. M. K. Brady the larvæ of *Ambystoma opacum* are capable of surviving for several weeks if it happens that the ponds dry up during winter. The larvæ disappear with the water, embedding themselves in the mud, and reappear when the ponds fill again. It would have been desirable to study this interesting adaptation in the laboratory; unfortunately, it was only possible to carry out one preliminary experiment. Several larvæ were kept for a number of

days in mud just saturated with water, during which time they remained perfectly motionless, to become active again a few minutes after the mud had been covered with a layer of water.

At a later stage, and until metamorphosis sets in, the larvæ are grey above and below, with black spots on the upper parts, especially in the fins and on the sides of the tail, making these animals appear fairly dark. There are, however, three generally well-defined rows of lighter spots on each side. The first consists of rather irregular spots on the back, right along the dorsal fin; these become larger and more numerous on the tail. The spots of the second row are rounded and regularly disposed; they begin behind the upper gills, and stretch along the flanks, to disappear gradually on the sides of the tail. The third row consists of very apparent and numerous round spots, and starts beneath the fore limb; it curves upwards behind the axilla, is very conspicuous all along the flanks, curves down again to pass beneath the hind limb, and continues along the tail, where it meets the end of the second row.

If kept on light or dark ground the larvæ of *Ambystoma opacum*, like those of other Caudata, adapt their colour to suit the surroundings. They become a brownish white almost without any markings on a white ground, or a uniform dense black if kept on a black ground. This adaptation seems to have no influence on the pattern the animals assume after metamorphosis. Some specimens kept on white during the whole of their larval life became quite normally pigmented once metamorphosed. Those raised on black unfortunately died before or during metamorphosis.

Once started, metamorphosis proceeds very rapidly, and is completed in about one week. Along with the disappearance of the other larval characters the coloration of the upper parts changes very materially. Numerous more or less confluent silver-grey dots appear all over the surface, and more particularly on the head and the flanks, while the ground-colour darkens to a black. The adult pattern gradually evolves out of this intermediate stage through the disappearance of the silver-grey dots in some parts and their extension in others. There are considerable individual variations in the rate of this evolution; while in some specimens the adult pattern is outlined a few days after metamorphosis, it may take six months in others before it becomes distinct. Part of the young raised in captivity have irregular markings very different from those of the parents.

The length at metamorphosis varied between 58 and 77 mm., and fifteen months later had reached 95 to 104 mm. About this time, *i. e.*, during the second autumn of their life, the young males began to show signs of sexual activity, and were seen to pursue the young females as well as each other in the above-described manner. One male could be observed depositing two spermatophores in succession at an interval of about half a minute. On microscopical examination, however, the sperm was found to consist solely of the above-mentioned long filaments, and spermatozoa could not be detected. This, and the fact that no eggs were laid, seems to indicate that full sexual maturity had not been attained.

XXXIII.—*Some more South African* Masaridæ (*Vespoidea*). By Dr. A. von Schulthess, Zürich *.

I. Masaris, Fab.

Antennæ of the male underneath flat, with linear tyloids on joints 6–12	1. *M. discrepans*, Brauns.
Antennæ of the male underneath without distinct tyloids, but tuberculate on joints 7–12 (fig. 1)	2. *M. braunsiella*, sp. n.

1. *Masaris discrepans*, H. Brauns.

H. Brauns, Entomol. Mittlgn. vol. ii. p. 203, t. ii. fig. 9 *a* (1913).

Antennæ (male) underneath flat, armed with linear tyloids on joints 6–12.

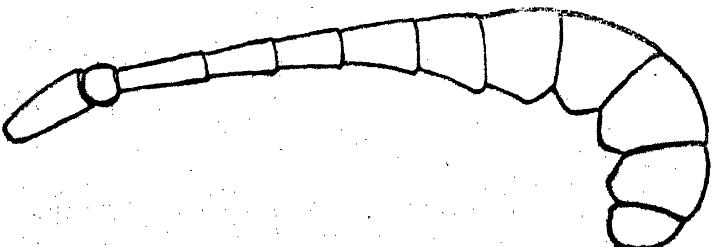
Hab. Cape Province, Matjesfontein, 2 ♂, 1 ♀, 7–27 Nov., 1928 (*R. E. Turner* leg.).

Var.—♂. Clypeus and front quite black.

Hab. eod. loco. 1 ♂ (*R. E. Turner*, leg.). Brit. Mus. London.

Also from S.W. of the Cape Province, Worcester, Oudtshoorn, Willowmore.

Fig. 1.



Antennæ of *Masaris braunsiella*, ♂.

2. *Masaris braunsiella*, sp. n. (Fig. 1.)

♂. Agrees in all respects, in size, sculpture, as well as in colour-pattern, with the ♂ of *discrepans*; only the joints of the antennæ 7–12 are broader than long and show underneath a conus-like enlargement (see fig. 1). ♀ unknown.

Hab. Cape Province, Matjesfontein, 1 ♂, 26–30.x.28 (*R. E. Turner* leg.). Type, Brit. Mus. London.

Named in honour of the late Dr. H. Brauns, Willowmore, who contributed so much to the knowledge of South African Hymenoptera, especially the Masaridæ.

* See Ann. & Mag. Nat. Hist. ser. 10, vol. iii. pp. 498–511 (1929).

II. Quartinia, Grib.

The table published on p. 504 (Ann. & Mag. Nat. Hist. (10) iii. 1929) may be completed as follows:—

1. Only one cubital and one discoidal cell in the fore wing	*Quartiniella*, Schulth.
Two cubital and two discoidal cells in the fore wings	2 *a*.
2 *a*. Principal colour of the abdomen black, without any red (whether always?) (except *variegata*)	2 (p. 504).
At least the hind segments of the abdomen red or testaceous	9.
9. Head and thorax very densely punctured, *i. e.*, covered with large, shallow, well-defined punctures; spaces between the punctures dull, densely reticulate (type, *scutellimacula*); abdomen shagreened, at the most the fore part of the tergites indistinctly punctured	10.
Head and thorax with dispersed deep punctures; spaces between the punctures polished; abdomen distinctly punctured (type *vagepunctata*)	12.
10. Clypeus but little broader than high. Hind margin of pronotum, three spots on dorsulum, a broad fascia on hind margin of scutellum, and the middle of all the tergites testaceous. 4 mm. (fig. 2)	*Q. pœcila*, sp. n.
Clypeus much broader than high (see fig. 3)	11.
11. Dorsulum black, with a white spot in the middle near the hind border (very seldom wanting); propodeum black; abdomen without red colour	*Q. scutellimacula*, Schulth.
Dorsulum with white markings; scutellum with a broad white margin along the hind border; propodeum with white lines on the sides. Abdomen more or less red-coloured	*Q. variegata*, Brauns.
12. Large species; 5 mm. Dorsulum without white or yellow markings. Abdomen red, with very narrow fasciæ	*Q. punctulata*, sp. n.
4 mm. Thorax richly adorned with brilliant white colour. Fasciæ of the tergites rather large	*Q. niveopicta*, sp. n.

Quartinia pœcila, sp. n. (Fig. 2.)

♀. Nigra, luxuriose albo- vel læte aurantiaco-varia. Alba sunt: flagellum antennarum subtus, maculæ duæ supra clypeum, macula magna sinum oculorum replens et macula longa pone oculos. Color albus hinc illinc in colorem læte aurantiacum transiens. Sic sunt plus minus læte aurantiaci: margo posticus pronoti, macula in propleuris, maculæ 5 dorsuli, i. e. duæ prope marginem anteriorem, duæ laterales prope tegulas, magna rectangularis ante scutellum, tegulæ, fascia lata in margine postico

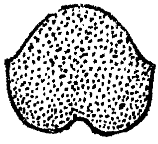
scutelli, fascia tenuis postscutelli, macula in latere segmenti medialis, macula sub alas et pedes, coxis et femoribus nigris exceptis. Abdominis tergita basi nigra, medio fascia lata læte aurantiaca, marginem posticum versus fascia tenui albida, antice bisinuata ornata. Venter niger. Alæ hyalinæ.

Long. corp. tot. 4 mm.

♂. Differt mandibulis, antennis (clava straminea excepta) labro, clypeo, facie tota et pronoti marginis anterioris et posterioris fascia læte candidis.

Long. corp. tot. $3\frac{1}{2}$ mm.

Fig. 2.



Clypeus of *Quartinia pœcila*, ♂.

Hab. Cape Province, Swakopmund, 2 ♂, 2 ♀, 2–4.xiii.28 (*R. E. Turner* leg.). Brit. Mus. London.

♂ ♀. Caput et thorax opaca, valde dense aciculata (shagreened), punctis dispersis lævibus, bene limitatis obtecta (sicut in *scutellimacula*). Clypeus eodem modo sculpturatus, quam altior vix latior, angulis inferioribus rotundatis (conf. fig. 2), margine inferiore angulatim excisus, margo ipse reflexus. Anguli laterales pronoti rotundati. Segmenti medialis cavitas bene limitata, opaca, angulis lateralibus nullis. Mesopleuræ et latera segmenti medialis uti dorsulum sculpturata. Abdomen læve, margines tergitorum fusco-translucentes. Alarum cellula radialis brevis, vix duplo longior quam latior; cellula cubitalis 2, antice valde angustata; ejus sector radialis brevior quam dimidia pars venæ transverso-cubitalis 1.

♂. Tergitum ultimum profunde incisum; sternitum ultimum margine postico sinuatum.

This species belongs to the group *scutellimacula*, with the characteristic kind of sculpture of head and thorax. While in other species the clypeus is much broader than high, here it is scarcely so, but nearly as broad as high, and the lower angles are rounded, not sharp.

Quartinia variegata, Brauns, in litt. (Fig. 3.)

= *Q. signata*, Brauns, Schulthess, *l. c.* p. 507. no. 5.

Dr. H. Brauns, Willowmore, sent some specimens of this [illegible] the British Museum, under the designation "*Qu.* [illegible]" To me he sent specimens of the same species with [illegible] written by his own hand. Both species

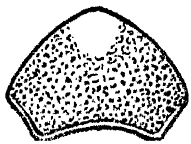
remained undescribed. As the name "*variegata*" has already been published by Bradley in his 'Taxonomy of the Masarid Wasps,' 1922, p. 401, I think the name *variegata* ought to be maintained, and *signata* become a synonym.

Quartinia punctulata, sp. n.

♀. Nigra, abdomine rufo. Mandibulæ fuscæ. Caput nigrum. Eburnea sunt: antennarum flagellum subtus; fascia sat lata et elongata pronoti; tegulæ; maculæ magnæ in parte exteriore scutelli; postscutelli fascia tenuis, genua et tibiæ omnes; abdominis fasciæ quinque præapicales, lateribus abbreviatæ. Alæ hyalinæ. ♂ ignotus.

Long. corp. tot. 5 mm.

Fig. 3.



Clypeus of *Quartinia variegata*, ♂.

Hab. Cape Province, Matjesfontein, 1 ♀, 1–6.xi.28 (*R. E. Turner*, leg.). Brit. Mus. London.

Totum corpus valde et grosse punctatum. Clypeus convexus, densissime et grosse rugoso-punctatus, apice truncatus; margo ipse lævis, leviter reflexus. Latitudo clypei: altitudo minima = 30 : 20. Caput et thorax grosse et profunde punctata; interstitia inter puncta quam puncta ipsa valde majora, subtilissime aciculata, fere lævia, polita. Mesopleuræ et 1 tergitum abdominis uti dorsulum punctata; latera segmenti medialis dispersius punctata. Tergita cetera quam primum valde subtilius et dispersius punctata. Sternita uti tergita punctata, eorum margines late depressi, fusci. Alarum cellula radialis fere duplo longior quam latior; 2 cubitalis quam latior longior; ejus margo radialis æque longus ac nervus transverso-cubitalis primus.

This species has a great affinity with *Q. vagepunctata*, Schulth., but the wholly red abdomen, the size of the clypeus and of the first cubital cell distinguish it.

Quartinia niveopicta, sp. n.

♀. Caput et thorax nigra; abdomen ferrugineum, albido-fasciatum. Caput et thorax luxuriose niveopicta. Mandibulæ, labrum et antennæ supra fuscæ. Nivea sunt: flagellum subtus; clypei maculæ tres, quarum una basalis, duæ apicales; fascia lata frontis oculorum sinum complens; macula maxima pone oculos; fascia lata in margine anteriore et posteriore pronoti; dorsuli

maculæ tres, quarum magna ante scutellum; fascia latissima in margine posteriore scutelli, linea tenuissima postscutelli; macula magna segmenti medialis; macula magna sub alis; genua et tibiæ. Femora nigra; tarsi refescentes. Alæ hyalinæ. Abdomen fasciis ochraceis quinque ornatum, quarum prima lata, lateribus valde aucta, ceteræ angustiores, medio et lateribus auctæ. Sternita unicoloria, ferrugineo-fusca. ♂ ignotus.

Long. corp. tot. 4 mm.

Hab. Cape Province, Matjesfontein, 4 ♀, xii.1928 (*R. E. Turner* leg.). Brit. Mus. London.

Caput, pronotum et mesopleuræ dense punctata; interstitia inter puncta subtiliter coriacea; dorsulum et scutellum valde disperse et sat grosse punctata; interstitia inter puncta coriacea. Pronotum latum, truncatum, angulis lateralibus rotundatis. Planum posticum segmenti medialis latum, disperse punctatum, nitidum, acute marginatum, dentibus lateralibus carens. Latera segmenti medialis rugulosa. Abdomen subtiliter et densissime punctulatum. Alarum cellula radialis plus quam duplo longior quam latior; 2 cellula cubitalis antice valde angustata, ejus sector radialis quam venæ transverso-cubitalis prima dimidia pars brevior vel non longior.

Clypeus apice leviter emarginatus, ejus margo inferior reflexus. Clypei latitudo : altitudo minima : 27 : 18.

Q. niveopicta, sp. n., shows a very dispersed punctuation on dorsulum and scutellum and a very fine and close one on the abdomen. Head and thorax are very richly adorned with white markings; the fasciæ of the abdomen, which is ferruginous, are yellowish, the first one rather large, especially widened on the sides; the following ones enlarged in the middle and on the sides.

XXXIV.—*Notes on the Cephalopoda.*—No. 11. *On a new Species of* Benthoctopus *from Patagonia, with Remarks on Magellanic Octopods.* By G. C. Robson, M.A.

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In 1929 I described *Enteroctopus eureka* from the Falkland Islands (1929, p. 179), and commented on the likeness which its radula displayed in one important respect to that of *Benthoctopus*. At the same time I included (*loc. cit.* p. 41) in the latter genus *Octopus hyadesi*, Rochebrune & Mabille, because the specimens bearing that name in the Paris Museum were found to have no ink-sac. On further examination, however, I find that *Enteroctopus eureka* is likewise devoid of the ink-sac, and, furthermore, that it has some

points of resemblance to the supposed examples of *hyadesi*, though it is not conspecific with them. I also find that the so-called *hyadesi* are not to be identified as such from the type-description. I am, therefore, describing them under the name of *Benthoctopus magellanicus*, and relegating "*Octopus hyadesi*" to the category of "insufficiently diagnosed species."

Benthoctopus magellanicus and *Benthoctopus eureka* seem to form a special group characterized by the form of Needham's organ, the penis and hectocotylus. The description of the hectocotylus of *eureka* given by me (1929, pp. 180–81) scarcely emphasises sufficiently the shallowness (? absence) of the copulatory groove and the general likeness of the organ to that of *magellanicus*. Into the same group should probably go an unnamed species originally described as *Polypus brucei* by Massy and referred by me as *Enteroctopus* sp. (*loc. cit.* p. 181).

In 1889 Rochebrune and Mabille described *Octopus hyadesi* (1889, p. H 6). Their description is as follows: "corps ovoïde, couvert de petites verrues et de rides, ces dernières plus particulièrement disposées sur la région antérieure. Tête large, faiblement cubique, à yeux très petits ; bras robustes, larges surtout à leur insertion, quadrangulaires, fortement recroquevillés à leur extrémité libre, portant des cupules très rapprochées, en forme d'étoiles ; la membrane de l'ombrelle est à peine visible . . . gris noirâtre sur toutes les régions supérieures, teinté en dessous de gris rougeâtre sale. Long. corps. 0·012 ; lat. corp. 0·008 ; long. med. brach. 0·015." During a visit in 1928 to the Musée d'Histoire Naturelle in Paris, where the "Cap Horn" specimens are deposited, I was enabled by the kindness of Professor L. Joubin to examine the collection of Octopods. I was unable to find therein any specimen that could reasonably be regarded as the type of *hyadesi*. There are, however, two large specimens (♂ ♀) labelled (I believe, in de Rochebrune's handwriting) as "*Octopus hyadesi.*" Now, as will be seen later, there is very little resemblance between these two specimens and *hyadesi* as described by Rochebrune and Mabille, and I am quite certain that they should not be treated as conspecific. I propose, therefore, to retain the name *hyadesi* for the small and probably immature octopod which is missing. The original description is defective and does not allow us to form any clear notion of the identity of Rochebrune and Mabille's specimen. It may or may not have been an immature stage of the so-called "*hyadesi*" adults. At all events, the latter are not recognizable as "*hyadesi*" from the original description. In view of this

difficulty it seems best to describe the adult forms under a new name and allow *hyadesi* to sink into the limbo of unidentifiable forms.

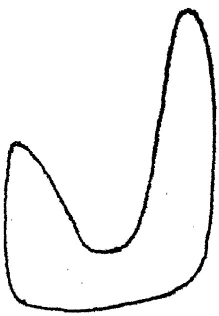
Benthoctopus magellanicus, sp. n.

Syntypes.—♂ ♀, in the Musée d'Histoire Naturelle, Paris.

Locality.—Orange Bay, S. Patagonia.

Description.—The body is bursiform and about as wide as long. The head is rather narrower than the body (83–78 per cent.). The arms are in the order 2.3.1=4 and are probably subequal. They are 78–74 per cent. of the total length. The suckers are small (10–9·2 per cent. of the mantle-length), without discontinuous enlargement. The basal cup is fairly thick-walled, its base being 1·7 mm. in thickness. The web has the formula C.B.=A.D.E or B.A.C.D.E. It is 32–31 per cent. of the longest arms. The surface of the female is

Fig. 1.



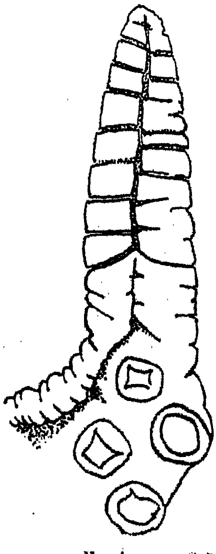
Benthoctopus magellanicus, × 4. Right limb of funnel-organ.

in a very bad condition, but it bears some obsolete warts not unlike those seen in the male. The sides of some of the arms show traces of a definite pustulation. The male is in a different state of preservation and the skin is covered with close-set, irregular, flat prominences which may be actually warts or the product of wrinkling. There are no cirrhi in either male or female. In both male and female the surface was probably originally of a light purple colour variegated with an irregular dark maculation. The mantle-aperture is rather wide (B–C). The gills have 9–7 filaments in each demibranch. The inner demibranch is only slightly shorter than the outer. The funnel is small, but prominent and rather pointed in both specimens. In the female the funnel-organ has the very peculiar form seen in fig. 1. In the male it is very badly preserved. I believe that in the female the

organ is double, but its preservation is not very satisfactory. There is no trace of an ink-sac in either specimen.

Reproductive Organs.—The hectocotylized arm is 75 per cent. of the longest arm. The ligula is 8·5 per cent. of the arm. The calamus reaches to about a third of the distance from the last sucker to the tip of the ligula. Whether the organ was in process of seasonal change or whether it constitutes a new type is uncertain. It is, however, very different from any type known to me in so far as it is, though otherwise fully formed, devoid of a copulatory groove (see fig. 2). The longitudinal furrow seen in the drawing is quite superficial. The internal male organs are rather like those of *Benthoctopus eureka.* The distal extremity of Needham's

Fig. 2.



Benthoctopus magellanicus, × 8·5. Hectocotylus.

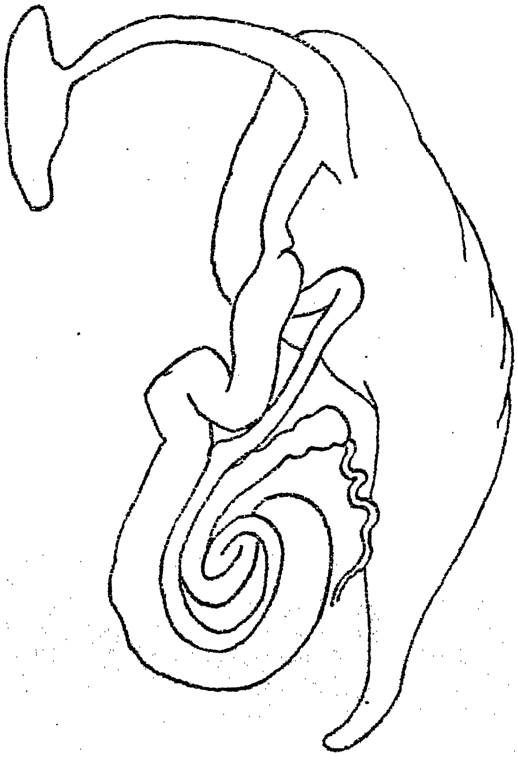
organ is very broad and its proximal end small. There is, however, no appendix penis as in *eureka.* The spermatophores are very numerous and slender. They measure about 52 mm. in length. The penis has a long diverticle.

Female.—The ovarian eggs are remarkably long and narrow. They measure 19 × 5·5 mm. The spermoviducal glands are simple and very large. They have been accidentally flattened, but seem to be 16–17 mm. in diameter.

I have included under *magellanicus* both the male and female specimens. The latter is not exactly like the male. Its arms are longer and the web-pattern is not the same. In

most of the other characters they are alike. *Magellanicus* differs from *eureka* in (1) its sculpture, (2) the size of the suckers, arms (the range overlaps), and web, (3) the form of the web, and (4) the lack of a penial appendix. It differs from *Enteroctopus megalocyathus* in (1) the lack of the ink-sac, (2) size of the suckers and arms (the range overlapping),

Fig. 3.



Benthoctopus magellanicus, ×c. 2. Male genitalia.

and (3) the depth of the web. It is, of course, possible that it may be the same as Orbigny's enigmatic *Octopus tehuelchus*. But not only is that species described very inadequately but the web is longer in *magellanicus* and the surface in *tehuelchus* is said to be smooth.

Bibliography.

Robson, G. C. 1929. "A Monograph of the Recent Cephalopoda," vol. I. British Museum, London.
Rochebrune, A. de, & Mabille, J. 1889. Mission Scientifique du Cap Horn. Zoologie, vi.

BIBLIOGRAPHICAL NOTICE.

Insects, Ticks, Mites, and Venomous Animals of Medical Importance.—Part I. *Medical.* By Prof. W. S. PATTON and A. M. EVANS. Crown 4to. x+785 pp., 374 text-figs., 60 plates. 1929. Price 20*s.* post paid.

THE present volume is the first of a series, of which the subsequent parts are to deal with Insects, etc., in relation to Public Health, to Tropical Hygiene, and to Veterinary Practice; it is intended to replace Patton and Cragg's 'Text-book of Medical Entomology,' which is now out of date and out of print. The authors state that it has primarily been written for the Medical Officer who approaches the subject for the first time—hence the justification of the 150 pp. devoted to morphology. Perhaps, however—so the authors say,—the most weighty reason for writing the book is to provide the Medical Officer with the information necessary to enable him to investigate a problem of disease transmission by Insect or Acarid, and thus to advance our knowledge.

The scheme of the book follows the course for the D. T. M. Liverpool; and the matter is therefore divided under 28 meetings of two hours each, partly lecture and partly practical class. Of these meetings, one is introductory, and the next five are concerned with the external and internal anatomy of an Arthropod, as exemplified mainly by that of the Diptera; the systematic study of the various families, etc., is then taken up; two meetings are mainly occupied by class examinations. In 26 meetings 558 demonstration specimens (all described in the volume) are examined; 30 pp. of text, with the examination of over 20 demonstration specimens per meeting is fairly good going.

Let it be said at once that the book is, on its own lines, an excellent one. The previous history and experience of the authors guarantee the accuracy of the matter; the treatment is in general full and adequate; and the illustrations are numerous, clear, and helpful. The print is good; and in addition to the figures in the text there are 60 half-tone plates, all of good quality and some really artistic. The students of the Liverpool School are fortunate in the first place in having such a well-arranged, useful, and interesting course, and in the second in possessing such a help to mastering it as is provided by this volume.

Most of the few criticisms which follow are prompted by the desire to see the book widely used by other medical schools also, and by the feeling that the authors have not quite given it the chance it deserves. Thus the lectures as they appear in the book are in many places mere synopses—*e. g.*, the structure of a louse is given thus:—"External structure of a Louse. Brief reference to the main structural characters of the body louse. For detailed structure of the human lice *see* demonstration specimens. Internal Anatomy. *See* demonstration specimens." Or again:—"Air-Sacs. Explain briefly their structure and function. Tracheal and Blood Gills. Explain briefly the process of respiration by tracheal and

blood gills with examples." Or:—"Fat Body. Its structure and functions briefly explained. Its appearance in dissections and sections noted." In some of these cases the student will get part of what he wants from the demonstration specimens described further on in the book; in other cases he will not.

The directions for practical work consist mainly of descriptions of the series of slides used in Liverpool. Take, for example, specimen 48, labelled thus:—"Dorsal view of labrum-epipharynx, hypopharynx, and pharynx of ♀ *Phlebotomus taianensis* from North China, cleared in caustic potash, and mounted in Canada balsam on a slide. Fig. 76. Under one-sixth objective. Please do not move the slide." Half a page of description follows, with a figure. This is all very excellent—for the Liverpool student; but it may happen that another school may not possess an identical specimen, or (to take the example on the previous page) may not have a "transverse section through pharynx of *Anopheles rossii* (*subpictus*) at junction of mid- and post-pharynx." It fact, it seems possible that a certain amount of the practical sections of the book will be inapplicable to the courses in most other schools.

The index is a most important part of such a work as this; but it is quite impossible to discover what purpose the present index is meant to serve, or on what plan it has been prepared—thus, among a number of terms thought of quite at random, Palp, Clypeus, Proventriculus, Elytron, Anus, Ovary, Bursa copulatrix, Malpighian tube, Tarsus, Labium, Blood, Haustellum, Labellum, Capitulum (tick), Chelicerae (tick) do not appear in the index (though, of course, they are found, often with a lengthy and excellent treatment, in the text); while the following do appear:—Halter, Proctodæum, Œsophageal diverticulum, Cephalic gland, Coxal gland, Gene's organ, Jelly fish, Medusæ, Mollusca, Zoo-geographical regions. The large chart, attached to the cover only by a strip of gum, will soon tear out. It is a pity that the authors have allowed so many of the excellent, and often artistic, figures to be defaced by large initials of the artist (many glaring examples are found in the 7th and 8th meetings); a better place for these would have been in the legends. The copious gilding of the front cover seems in doubtful taste.

In conclusion, a word must be said as to the price—20*s*. This is extraordinarily cheap, the more so since it includes packing and postage to any part of the world. The authors explain that they have published the book themselves in order to be able to sell it as cheaply as possible; we hope that the result of their enterprise will amply justify them in their venture. The book can only be obtained from the Entomological Department, Liverpool School of Tropical Medicine.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[TENTH SERIES.]

No. 28. APRIL 1930.

XXXV.—*Notes on* "Carcinophyllum," *Nich. & Thom., with Descriptions of Two new Species.* By the Rev. T. A. RYDER, B.Sc., Ph.D., F.G.S.

I. INTRODUCTION.

The Avonian Rugose genus, *Carcinophyllum*, was founded by Nicholson and Thomson in 1876, but it received little attention until the late Dr. A. Vaughan, in 1905, and, subsequently, other workers on the Avonian succession, described additional species which they referred to the genus.

This paper is an attempt to fill the gap which, at present, exists in our knowledge of the development and relations of these forms. They and certain other species have been re-described, using modern anatomical nomenclature; ontogenesis and phylogenesis have been, in part, described, whilst two new species are described and figured. A large number of specimens have been examined and many thin sections made in order to arrive at the facts and conclusions set out below.

The author tenders his thanks to Dr. Stanley Smith, Dr. F. B. A. Welch, and Dr. T. N. George for the use of material collected by them; to Dr. W. D. Lang, Prof. S. H. Reynolds, and Dr. A. E. Trueman for access to the geological collections in the British Museum of Natural History, the University of Bristol, and University College, Swansea, respectively; and to Dr. S. Smith for advice and encouragement. During the pursuance of the research, the author was in receipt of a monetary grant from the Council of the Royal Society, to which body thanks are also offered.

II. The Genus *Carcinophyllum*, Nich. & Thom.

1876. Nicholson and Thomson, Ann. & Mag. Nat. Hist. ser. 4, vol. xviii. p. 70.—Name only, no description given. Text-figure on page 71 shows transverse section of central column.

1879–80. Thomson, Proc. Phil. Soc. Glasgow, vol. xii. pp. 241–244.—Description of genus given.

1906. Vaughan, Proc. Bristol Nat. Soc. ser. 4, vol. i. pt. ii. (issued for 1905), pp. 147–148.—Short description of genus and text-figure of transverse section of corallite given.

Thomson gave the following generic characters:—

"Corallum simple, cylindro-conical or cornute. A boss may be seen in the calyx. The septa are good, both major and minor being present; they never reach the centre. Dissepiments are numerous; internal structure is triareal. Central area occupied by irregular, anastomosing, vesicular tissue, which surrounds a central, irregularly-formed, medial plate."

Distinguishing characters of genus, according to Thomson, are:—(1) In transverse section the reticulate anastomosing structure of the central area widely different from that of any other genus; (2) The genus does not possess an inner wall around the central area, therefore differing from *Cyclophyllum* forms; (3) The floor of the calice never presents the form of a small or inner cup; (4) In longitudinal section, the lamellar plates are sparse, and tabulæ remote and hardly recognisable.

Thomson further remarked that the genus was separated from *Lonsdaleia*, M'Coy, by the much more highly developed septal system and the reticulate structure in the central area, and also in the fact that, in longitudinal sections, the central area is seen to be composed of irregular, sparse, discontinuous lamellar plates and the endothecal dissepiments are hardly recognisable, whilst in similar sections of *Lonsdaleia* there is a mesial plate in the columellarian axis, extending throughout the corallum.

Vaughan states: "This genus is usually simple, but compound forms have been found. Central area is oval and with a well-defined boundary; mesial plate short, and entirely surrounded by a reticulate network; lamellæ approximately equal in number to major septa"; and he then adds, "The essential distinction from *Lonsdaleia* lies in the structure of the inner wall . . . . in later forms from S_2 and D_1 . . . . inner wall is formed by the forking of the septa at their base and by the union of the branches from two adjacent septa. It is not, however, unusual to find, in specimens from D_1, that the inner wall is weakly vesicular." He suggests that *Lonsdaleia* is possibly a direct derivative from *Carcinophyllum*.

Remarks.

1. Thomson defines the genus as simple, and from the ontogeny of species described below this statement may be deemed true. No compound forms have been seen by the present author; and the term "*Carcinophyllum*" is, therefore, restricted to simple forms.

2. Thomson's figure of longitudinal section (fig. 7*b*) disproves his own statement that "Tabulæ are remote and hardly recognisable," since it shows good tabulæ.

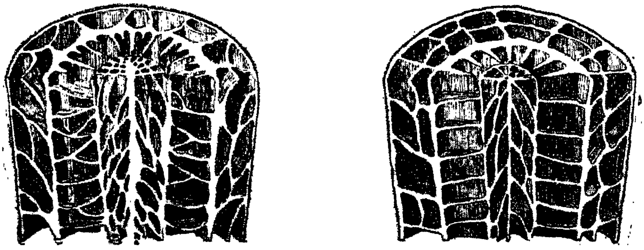
3. Thomson states that there are "numerous dissepiments," but adds, later, "outer area is composed of large, few dissepiments," and his figures confirm this. What Thomson probably meant by his first statement was interseptal tissue.

4. The central column may or may not be well marked off from the tabular zone, but usually is, in longitudinal sections.

5. Vaughan's remarks on formation of inner wall, or theca, by septal forking may be regarded as an error, since such has been demonstrated to be impossible.

6. Thomson founded his genus on one species only. Vaughan and others subsequently referred other species to it.

Fig. 1.



Simplified solid sketches to show main differences between typical forms of the two genera "*Carcinophyllum*" and *Lonsdaleia*. These diagrams are not to scale nor do they represent any particular species of either genus.

Genotype of *Carcinophyllum*, Nich. & Thom.

C. kirsopianum, Nich. & Thom. Ann. & Mag. Nat. Hist. ser. 4, vol. xviii. text-fig. p. 71.

Described by Thomson alone in Proc. Phil. Soc. Glasgow, vol. xii. (1879–1880), p. 243, pl. ii. figs. 7, 7*a*, 7*b*, as from the Lower Carboniferous of Arbigland, Dumfries, Scotland.

Note.—The types of *C. kirsopianum* are missing, and no topotypes are available, therefore it is uncertain whether the group of corals referred to the genus by subsequent authors is congeneric with the type or not. In the present state of our knowledge, therefore, and to prevent prejudging the question, it has been deemed advisable here to designate such forms "*Carcinophyllum*," and take *C. vaughani*, Salée, as the type of that group. The use of the term does not imply congenericity of forms referred to it—in fact, there is evidence to show that "*Carcinophyllum*" is polyphyletic.

This grouping is purely tentative and temporary; further work may clear up the doubts that exist now, but it was considered convenient to do so, at this stage, in order to avoid creating new generic names which would later have been found useless.

Type of "*Carcinophyllum.*"

C. vaughani, Salée, Mem. Geol. Inst. Univ. Louvain, 1913, Tome i, p. 256, pl. x. figs. 2–12.

(=*Carcinophyllum* θ, Vaughan, Q. J. G. S. vol. lxi. (1905), p. 285, pl. xxiv. figs. 3, 3 *a*, 3 *b*.)

The holotypes of Vaughan's species were collected from the D_1 subzone of Sodbury, Gloucestershire, and Flax Bourton, Somerset.

III. Description of Species of "*Carcinophyllum.*"

"*Carcinophyllum*" *vaughani*, Salée *.

Synonymy.—See above.

External Characters.—The form is usually that of an elongated cone, often curved at the proximal end. The epitheca is strongly rugose—*i. e.*, growth-ridges, or annulations, are well developed, and, in later forms from D_1, the corallites usually bear hollow "root-like" processes at their proximal ends. The size of the corallites varies up to 30 mm. diameter and 60 mm. length. The calice is moderately deep, and the distal end of the central column arises as a small boss from the centre of the calicular floor.

Internal Characters.—The coral presents a tri-areal appearance in ephebic stages, but the outer or dissepimental zone is frequently absent, because its loose construction permits of its easy removal by weathering. The dissepiments, when present, are seen to be large curved plates, arranged, usually in one, sometimes in two rows, forming a zone equal in width to about one-third the radius of the corallite; they are of Lonsdaloid type—*i. e.*, they separate the septa from the epitheca. The septa, of which there are usually about 33 major ones present, arise from the theca and extend inwards almost to the central column, but do not actually reach it; they are straight and fairly stout. Minor septa are present, but, although stout, are short, and do not extend far into the intrathecal area. Fossulæ are not well marked—that is, the septa are more or less radially disposed. The theca is well marked and is often reinforced by secondary thickening.

The central column, oval in cross-section, occupies about one-quarter the diameter of the corallite, and is composed of a short medial plate surrounded by an anastomosing network of lamellæ—approximately equal in number to the major septa—arranged in a reticulate pattern. The central column is not always well marked off from the tabular area.

* The foregoing description is based on the holotypes and a number of topotypes.

Longitudinal section: The dissepiments are distally curved; the tabulæ are evenly spaced. The central column is made up of almost vertical tabellæ (it is the intersections of these that form the interlamellar tissue seen in transverse section). The central area is not usually marked off by a definite and distinct wall, but it can easily be recognised by the great difference in the angles of inclination of tabulæ and tabellæ.

Specimens from D_1 show old-age characters—*e.g.*, excessive development of the peripheral area and growth of "roots" (characters also seen in *Lonsdaleia*).

Horizons and Localities.—*C. vaughani* ranges throughout the S_2 and D_1 subzones of the Avonian, in the South-western Province of those rocks—*i. e.*, in the Bristol, Mendip, and S. Wales areas.

[*Note.*—Smyth * has described a form from the *Dibunophyllum* Zone of Ballycastle, Co. Antrim, Ireland, which appears from his description and figures to be a stunted specimen of *C. vaughani* at an advanced or gerontic stage. The "roots," which Vaughan noted as characterising specimens from high levels in D_1, are well developed. Smyth's description is as follows:—

"*Carcinophyllum* sp. (pl. iii. figs. 6 *a*, 6 *b*).

"As only one imperfect specimen of this species was found, I have not given it a name. It is a very small coral, with 'roots' arising in whorls. After being photographed it was cut into six transverse slices. Fig. 6 *b* is a drawing of section 4, which passes through one of the 'roots.' Figure 1 *a* is corallite showing external aspect."]

Lonsdaloid Variants.—Varieties of *C. vaughani*, occurring at various levels in different localities, show a marked convergence in general appearance to *Lonsdaleia*. The theca is not so well marked and the outer edges of the major septa penetrate the dissepimental zone to a slight degree; the central column loses, in part, its reticulate appearance and becomes looser in construction. These variants are usually of larger size than the normal form. They occur in the D_1 beds of Emborough, Mendip Hills, and in the Melmerby Scar Limestone of the North-West of England—*i. e.*, at about the same horizon.

Ontogeny (figs. 5 *a*–*l*).—The earliest stage obtained of *C. vaughani* shows a thick epithecal ring and one septum reaching almost across the calicle—this undoubtedly represents the axial septum. Slightly later the inner end of this septum is dilated, representing the beginning of the central column. Succeeding stages show that septal insertion follows the normal course, new ones entering at the cardinal and alar fossulæ. It should be noted that, as the corallite grows and new septa are inserted, the dilated

* L. B. Smyth, "On some new Species from the Lower Carboniferous of Ballycastle, Co. Antrim," Geol. Mag. 1922, pp. 21–24, pl. iii. Description of *Carcinophyllum* sp. on p. 24.

end of the cardinal septum throws out "shoots" in their direction. Even in brephic and early stages the septa rarely reach the central structure, and the cardinal septum soon breaks away from it. The central column takes on, at a comparatively early stage, its characteristic reticulate appearance. Minor septa do not make their appearance until a fairly late neanic stage has been attained (fig. 5 *l*).

The early developmental stages (figs. 5 *a–e*) are very similar to corresponding stages in *Lonsdaleia*; neanic stages of *C. vaughani* closely resemble the ephebic stage of *C. simplex*, Garwood, the species from C_2 which may be an ancestral form.

"*Carcinophyllum*" *mendipense*, Sibly *.

1906, Sibly, Quart. Journ. Geol. Soc. vol. lxii. pp. 369–370, pl. xxxi. fig. 4.

External Characters.—The corallum is troichoid in form. The largest corallite examined had a diameter of 25 mm. and length greater than 25 mm. The calyx is as in "*C.*" *vaughani*. Rugosity is not so well marked as in the latter species—*i. e.*, annulations are not so developed.

Internal Characters (fig. 2).—Transverse and longitudinal sections illustrate the tri-areal appearance. The central column is circular and well marked off from tabular area, and is seen to consist, in transverse sections, of a short thick medial plate which is entirely surrounded by thickened septal-lamellar tissue and thin tabellar intersections. The septal lamellæ are approximately equal in number to the major septa, but are not in continuation with them. The pattern of the central column, in transverse section, is essentially radiate, not reticulate, as in "*C.*" *vaughani* (fig. 5 *m–p*).

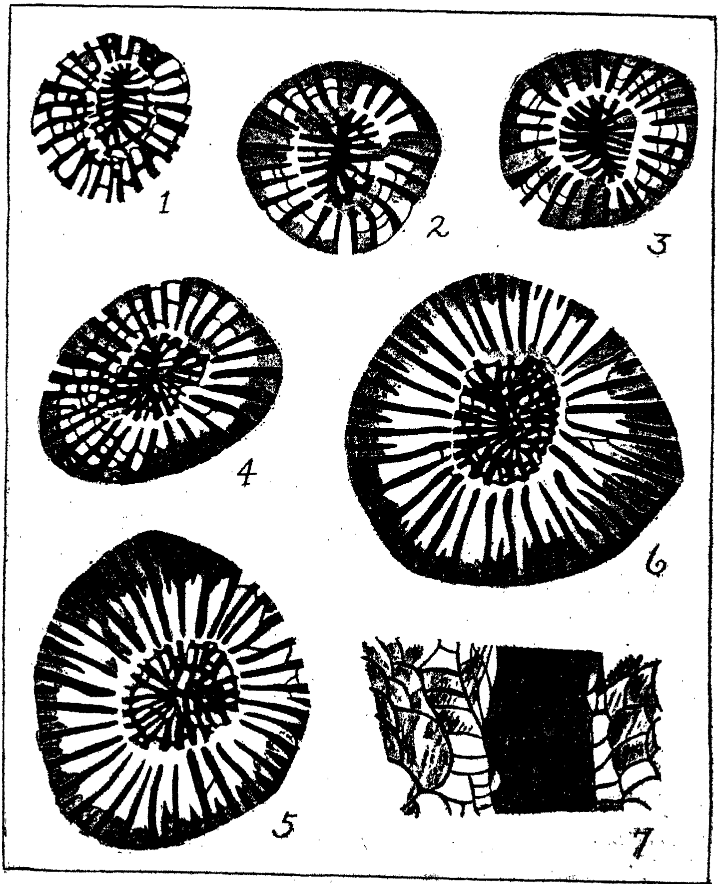
The major septa, 30–32 in number, are stout and well spaced, with blunt inner edges, and extend from the theca almost to the central column. Minor septa are better developed than in *C. vaughani*, being about half the length of the major. The theca is well marked, and is usually reinforced by stereoplasmic tissue, and the septa are often thickened as they pass through it. Fossulæ are not well seen.

The outer zone of dissepiments is usually absent, owing to its being easily weathered away, but when present is seen to be narrow, variable, and composed of large dissepiments which separate outer edges of septa from epitheca. The dissepiments are large plates, highly inclined, and convex distally. The tabulæ in the medial area are horizontal and widely spaced, but may be more or less broken up into curved tabellæ; this, however, is rarely seen. A few highly inclined tabellæ are seen in longitudinal sections of the central column, but this appears to be mainly composed of thick lamellar intersections in such sections.

* The following description is based on a paratype in the Sibly collection, University College, Swansea, and on a number of topotypes.

Localities and Horizons.—"*C.*" *mendipense* is characteristic of the S_1 subzone of the Avonian, in the Mendip area, but is rare in South Wales, except at the extreme eastern end, that is, to the north of Newport, Mon.

Fig. 2.



"*Carcinophyllum*" *mendipense*, Sibly. S_1, Black Rock, Cheddar, Somerset, coll. by Dr. Welch.

1–6.—Transverse sections, cut serially from one specimen.
7.—Longitudinal section.
All sections × 3·5.

"*Carcinophyllum*" *simplex*, Garwood.

Garwood, Quart. Journ. Geol. Soc. vol. lxviii. (1912), pp. 556–557, pl. xlviii. figs. 3 *a*–3 *c*, 4 *a*–4 *b*.

External Characters.—*C. simplex* is a simple cornute form, tapering fairly rapidly. The epitheca is marked by irregular annulations and coarse well-marked vertical striæ. Diameter varies up to 20 mm. and length up to 25 mm.

Internal Characters.—Transverse sections: in earliest sections the central area is occupied by a columella composed of a number of thick, irregularly-twisted, vertical lamellæ, the majority of which are continuous with the inner edges of the major septa. The spaces between these are almost filled with secondary stereoplasm, which is also deposited thickly in the inter-septal area. In later stages most of septa break away from lamellæ, but central column remains attached to one thickened major septum, which appears to be always the counter-septum. The major septa are thick, blunt, and few in number, 28 present at 17 mm. diameter, these are confluent at their base to form a thick Zaphrentid type of wall. The minor septa are inconspicuous in early stages, and when they first appear are buried in stereoplasm; in adult forms they are never more than one-quarter the length of the major. Only in calicinal sections are dissepiments seen, when they form large loose vesicles of true *Carcinophyllum* type.

Longitudinal section: the central area is composed of sections of the irregularly-twisted lamellæ that form the central column, connected by loose tabular tissue which pass outwards to the epithera very irregularly.

The species appears to be essentially a *Carcinophyllum*, although it is not until final stages that the non-septate dissepiments of the genus appear. The curious contorted central column is the simplest yet described for any species of the genus. The ephebic stage of this species bears a close resemblance to neanic stages of *C. vaughani*.

Horizon and Locality.—*Seminula gregaria* subzone ($=C_2$ Avon Section), Meathop, Arnside district, also occurs at same level as Marton, in Furness district.

"*Carcinophyllum*" *parkinsoni*, sp. n.

Holotype.—*Carcinophyllum* sp., Parkinson, Quart. Journ. Geol. Soc. vol. lxxxii. (1926), pp. 230–231, pl. xiii. figs. 2 *a*–2 *d*.

External Characters.—The corallum is simple and abruptly conical.

Internal Characters.—Transverse sections: earliest stage (15 mm. diameter, fig. 2 *a*, *op. cit.*) major septa are fairly thick and straight and reach epitheca, no minor septa, central column eccentric, well defined and consists of a thick, slightly undulating medial plate, from which the septal lamellæ project with a more or less pinnate arrangement. As growth proceeds (20 mm. diameter) minor septa and peripheral dissepiments occur. Dissepimental area very open in maturity and septa retreat from epitheca; there are 45 major septa present at 36 mm. diameter. The septa are coated with secondary stereoplasm and this completely fills the

spaces between them in outer part of intrathecal area. Central column becomes more complex as growth proceeds. In mature stage, the medial plate is relatively short and septal lamellæ assume a somewhat spiral arrangement (fig. 2 *b*, *op. cit.*). In oldest stage seen (44 mm. diameter, fig. 2 *c*, *op. cit.*) central column has a reticulate structure, recalling to a slight degree that of *Carruthersella*.

Longitudinal Section. — Axial tabellæ are arched strongly towards centre. Intratheral zone of horizontal and slightly inclined tabulæ and an extra-thecal zone of loosely and unevenly spaced dissepiments (fig. 2 *d*, *op. cit.*).

Locality and Horizon.—Coral Bed, Ravensholme Quarry, Pendle Hill, from *parasitica* subzone ($=D_2$). A specimen very closely resembling this form, if not identical, has been examined by the author from the D_2 beds of Derbyshire, where it was collected by Principal T. F. Sibly, and which is now in the Sibly Collection, University College, Swansea.

Discussion (from Parkinson's paper). — Apparently a new species, only one specimen found. Closest form seems to be the Arctic species of *Carcinophyllum* (Carruthers, 'Notes on the Carboniferous Corals collected in Novaya Zenbya by Dr. W. S. Bruce,' Trans. Roy. Soc. Edin. vol. xlvii. (1909), p. 152, figs. 8 *a*–8 *b*). Central column of Pendle form not quite so complex and reticulate, structure more pronounced, symmetry of central column bilateral, in Arctic form nearly radial.

"*Carcinophyllum*" *welchi*, sp. n.

Holotype.—From the base of S_1 subzone, Avonian of Black Rock, Cheddar, collected by Dr. F. B. A. Welch (figs. 3 A, B) (R 27583-4).

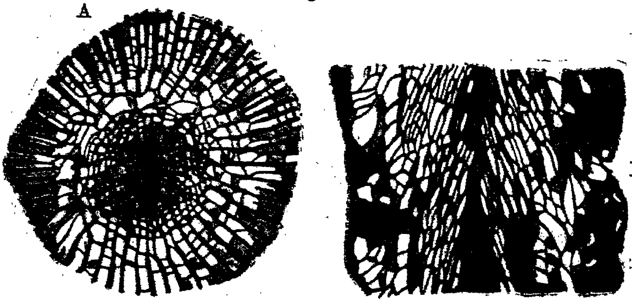
External Characters.—No details known.

Internal Characters.—Transverse section: the characteristic feature of the species is the central column, it being larger than in *C. mendipense*, Sibly, to which *C. welchi* approximates in general structure. In the latter species the central column occupies about one-half the interthecal diameter, it is not well marked off from the tabular zone. Three distinct zones can be recognized in the central column, but at their edges they grade into one another; these are an outer, less compact zone formed of the attenuated, flexuous edges of the major septa and some tabular intersections; a middle zone consisting of numerous straight, more or less radially arranged, septal lamellæ with tabellar intersections; and an inner zone, oval in cross-section and solid in appearance, formed of the inner edges of the septal lamellæ reinforced and fused by stereoplasm. This inner solid zone bears a superficial resemblance to the columella of *Lithostrotion*, especially in weathered specimens or calicular sections, for the outer looser portion of the central column is then absent. (Note that this thickened central column approximates to that of *Carruthersella*.)

There are about 44 major septa present; these are stout and straight for most of their length, but their inner portions taper off and become slightly flexuous, and many of them are in continuation with the lamellæ of the central column. Minor septa are long, straight, and stout, attaining about half the length of the major. The cardinal fossula is usually well marked, owing to the cardinal septum being slightly smaller than the other major septa and there being a somewhat wider gap between it and the two adjacent septa than between any two other major septa. Interseptal tissue, *i. e.*, tabular intersections, is fairly abundant.

Fig. 3.

A



B

Carcinophyllum welchi, sp. n.

A & B, transverse and longitudinal sections, × 2·5 diameters. Specimens collected by Dr. Welch from Carb. Limst. (S_1), Black Rock, Cheddar.

A. Transverse section. Specimen R. 27583, Brit. Mus. Nat. Hist.
B. Longitudinal section. Specimen R. 27584, Brit. Mus. Nat. Hist.

Longitudinal Section.—The dissepiments are convex distally. Tabulæ in interthecal area are broken up into tabellæ and inclined at a high angle towards the central column, which is not well marked off except where secondary thickening has emphasized its boundary. The central column is composed of numerous highly-inclined small tabellæ, which lean towards the central solid portion.

Locality and Horizon.—To date, the species has only been recorded from the base of the S_1 subzone, Black Rock, Cheddar, Somerset, where it occurs in association with *C. mendipense*, Sibly.

"*Carcinophyllum*" *densum*, sp. n.

Holotype.—Specimen collected by Dr. F. B. A. Welch from the D_3 subzone of Wrington, Somerset (B.M. R. 27582).

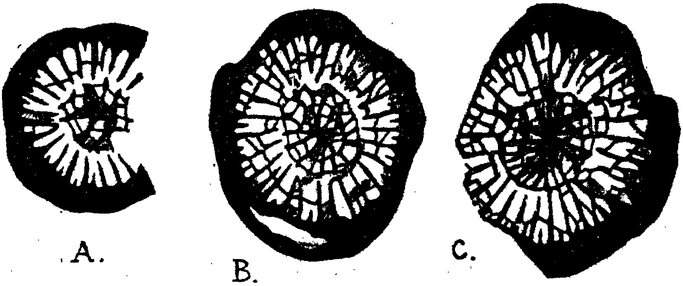
External Characters.—The species is cylindro-troichoid in form, attaining a diameter of, approximately, 13 mm., length up to 24 mm. No details of the calyx are known.

Internal Characters (fig. 4).—The most marked character, in all sections, is the stereoplasmically thickened dissepimental zone, which gives the form its trivial name.

The major septa—about 30 at 13 mm. diameter—are practically straight and fairly stout; they do not reach the central column in ephebic stages, and even in neanic stages are not always in contact with it. Minor septa are feebly developed, and when they first appear they are buried in stereoplasm, whilst in the adult they never attain any great length.

The central column is oval in cross-section, with a diameter of about one-third that of the corallite; it is simply constructed, consisting only of a few septal lamellæ—these are flexuous in early stages but straighten out as growth proceeds—arranged more or less radially around a medial plate. The central column, in ephebic stages, is usually reinforced by stereoplasm, and this tends to mask its structure. A little inter-lamellar tissue is present, *i.e.*, intersections of the inclined tabellæ. In this species the central column well differentiated from tabular zone.

Fig. 4.



"*Carcinophyllum*" *densum*, sp. n.

A–C, transverse sections, × approx. 2·8 diameters. All from Carb. Limst. (D_2 subzone), Wrington, Somerset. Coll. Dr. F. B. A. Welch. (Specimen R. 27582, Brit. Mus. Nat. Hist.)

"*C.*" *densum* bears a somewhat superficial resemblance to "*C.*" *simplex*, Garwood, and thus affords an example both of atavism and of the Petræoid trend*. The species affords, too, another example of the tendency of many Avonian Rugosa to lay down surplus stereoplasm just prior to their extinction.

Localities and Horizon.—*C. densum* has been found in the top beds of the D_1 subzone of Mynydd-y-Gareg, north-east of Kidwelly; in the D_2 beds of Llygad Llwchwr, South Wales, by Dr. T. N. George, M.Sc.; and in the D_2 beds of Wrington Quarry, Somerset.

IV. Ontogenesis. (Figs. 5 *a–l*.)

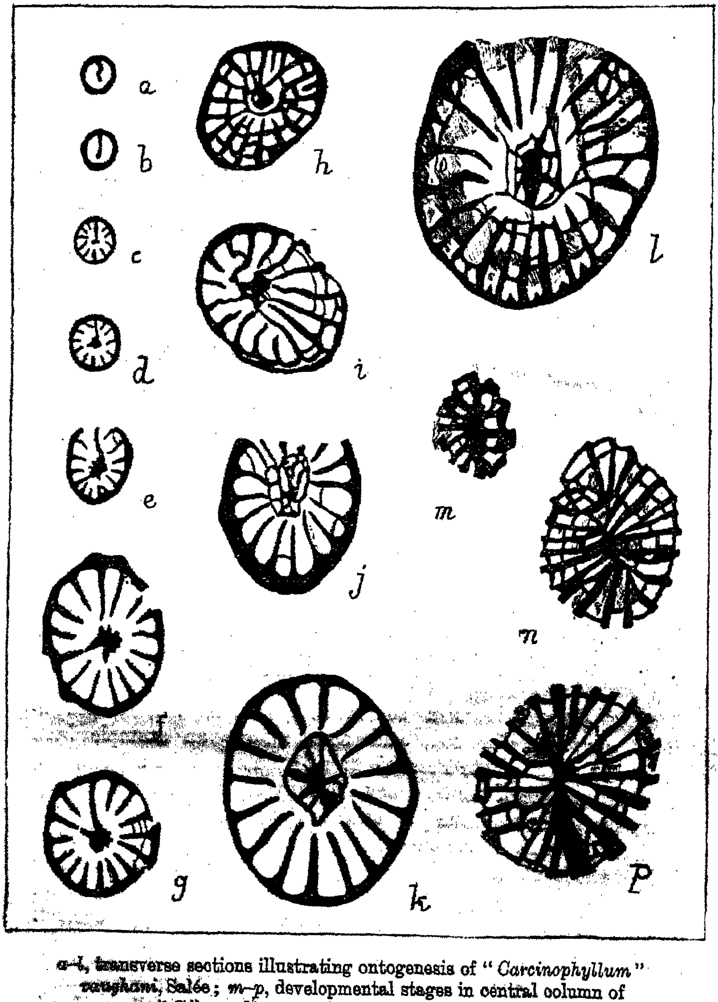
The following remarks apply more particularly to "*C.*" *vaughani*, but may be regarded as holding, in general, for other species.

Septal System.—The earliest stages obtained (figs. 5 *a*, *b*) show axial septum, which breaks into cardinal and counter septa.

* See W. D. Lang, Proc. Geol. Assoc. vol. lxxxiv. (1923), p. 128.

Cardinal septum is much longer and its inner end becomes dilated and throws out "shoots" in direction of septa, these "shoots" eventually become the septal lamellæ. The septal lamellæ, although

Fig. 5.



a–l, transverse sections illustrating ontogenesis of "*Carcinophyllum*" *vaughani*, Salée; *m–p*, developmental stages in central column of "*C.*" *mendipense*. Sections × 4–5 diameters.

phylogenetically connected with the septa, ontogenetically often arise separately and may or may not be linked to the inner edges

of the major septa. Septal insertion in the genus is normal, new septa appearing at cardinal and alar fossulæ. As new septa appear they are inclined towards the cardinal or alar septa, as the case may be (figs. 5 *c* & *d*). Minor septa do not make their appearance until a fairly late level in the neanic stage, and never attain any great length, except in "*C.*" *welchi*, in which species they have their maximum development for the genus, being one-half, or even more, the length of the major. Some or all of the major septa may reach the central column in neanic stages (figs. 5 *h* & *l*), but retreat from it before the ephebic stage is reached, except in "*C.*" *welchi*.

Tabulæ.—When tabulæ first appear, they are practically horizontal plates, slightly displaced by the central column, but as the coral grows, and latter structure becomes more complex, the tabulæ becomes broken up into curved plates, or tabellæ, inclined at varying angles to the central area.

Dissepiments.—In several series the dissepimental zone is nearly always absent in adult forms, because its loose construction renders it easy of removal by weathering. Dissepiments first appear in neanic stages, but not until minor septa have appeared and neanic stage has almost ended do the Lonsdaloid dissepiments, characteristic of most of the species, make their appearance. In "*C.*" *simplex*, the earliest species, dissepiments do not appear until the ephebic stage, being seen only in calicular sections, whilst in "*C.*" *densum*, the last species, the peripheral zone is filled with stereoplasmic tissue that masks all structures.

Central Column.—This arises from the dilated inner end of the cardinal septum, from which septal lamellæ arise. This stage is reached before a dozen septa have been inserted. The cardinal septum breaks away, at a fairly early stage, from the central structure, which develops by further increase in number of septal lamellæ, laid down in continuation of, but not usually in connection with, the major septa, and by a break-up of tabulæ tissue in inner area into highly inclined tabellæ. There is no distinct wall separating central column from tabular zone, but inclined tabellæ at boundary, occasionally reinforced by stereoplasm, often form a pseudo-wall. Variations from the normal reticulate type of central column occur, *e.g.*, in "*C.*" *welchi*, with its more complex form or central structure, and "*C.*" *simplex* with its simple form consisting only of a few spirally twisted septal lamellæ. The medial plate is usually short and irregular, except in "*C.*" *welchi*, where it is well marked, and is a survival of the cardinal septum. Structures are often marked by a secondary thickening as in some specimens of "*C.*" *mendipense*, and more especially in "*C.*" *densum*.

Theca.—This is formed by the junction of dissepiments and tabulæ, reinforced by stereoplasm, and by slight dilatation of outer edges of major and minor septa, which in ephebic stages arise from theral area. This combination serves to make the theca very distinct in most species.

V. Phylogenesis.

Vaughan * suggested that: "It is possible that *Lonsdaleia* is directly derived from *Carcinophyllum*, but the evidence is, as yet, very incomplete." Neanic stages of "*Carcinophyllum*" (fig. 5) very closely resemble similar stages in "*Lonsdaleia*" (*i.e.*, stages No. 2*a* and No. 2*b* of Dr. S. Smith †), and this fact, together with the similarity in general plan of the ephebic stages of the two genera, would tend to support Vaughan's suggestion. Mr. R. G. Carruthers ‡ has, however, put forward the theory that *Lonsdaleia* is derived from *Thysanophyllum pseudo-vermiculare*, since its early neanic stages bear a close resemblance to the latter genus, and Dr. Smith approves of this theory. *T. vermiculare* occurs in beds of C_1 and C_2 age, whilst the earliest "*Carcinophyllum*" yet described, "*C.*" *simplex*, occurs in beds of C_2 age.

A consideration of developmental stages of the three genera mentioned leads to the formulation of three possible theories, one or more of which may be correct. These are:—

(*a*) *Lonsdaleia* may be a direct derivative of an early "*Carcinophyllum*" (Vaughan's view).

(*b*) *Lonsdaleia* may be derived from *Thysanophyllum pseudo-vermiculare* (Carruthers's view), and "*Carcinophyllum*" merely be an example of close parallelism.

(*c*) All three genera may be derived from a plastic, early Tournaisian form.

The third view together with the second seem to be the more probable, for it would explain the close resemblance between *Lonsdaleia* and "*Carcinophyllum*," and also the great similarities between neanic stages of all three genera, since in such stages the traces of the common ancestor would not have been obliterated sufficiently to escape recognition. "*Carcinophyllum*" seems to be insufficiently plastic in neanic stages—when its adult characters, although infantile and partly masked, are yet discernible—to be the parent stock of *Lonsdaleia*, also if it were so, then *Lonsdaleia* would be a polyphyletic genus, since some species, and most probably all, of that genus are derived from *Thysanophyllum pseudo-vermiculæ*.

The close resemblance between neanic stages of "*C.*" *vaughani* and ephebic stages of "*C.*" *simplex* leaves little doubt that the former species is derived from the latter. "*C.*" *mendipense* does not appear to be an intermediate stage in that lineage but rather an offshoot, which in its turn gave rise to the specialised and more complex form associated with it, namely, "*C.*" *welchi*. "*C.*" *vaughani* at various times gave rise to Lonsdaloid variants. It is interesting to note how "*C.*" *densum*, the last species, simulates in general appearance the earliest recorded form,

* Proc. Bristol Nat. Soc. 4th ser. vol. i. pt ii. (issued for 1905), p. 148.

† Quart. Journ. Geol. Soc. vol. lxxi. pl. xvii. figs. 8–10.

‡ Ibid. lxviii. pp. 500 and 563.

"*C.*" *simplex*, thus affording an example of atavism in a declining stock. The secondary thickening, which accentuates this similarity, becomes progressively less as growth proceeds in "*C.*" *simplex*, but increases in amount as growth occurs in "*C.*" *densum*. The behaviour of the former species in this respect is analgous to the behaviour of certain simple Silurian corals *, whilst "*C.*" *densum* affords an example of the Petræoid trend.

XXXVI.—*An Interpretation of the Taxonomic Status of* Atya bisulcata, *Randall, and* Ortmannia henshawi, *Rathbun.* By PAUL L. RADIR, University of Hawaii.

[Plate XIII.]

WITHIN the family Atyidæ belonging to the tribe Caridea of the Decapod Crustaceans there appears to exist a plastic dimorphism among certain types occupying an identical ecologic niche which presents a taxonomic problem of particular interest.

In the Hawaiian Islands, two forms—*Atya bisulcata*, Randall, and *Ortmannia henshawi*, Rathbun—typifying this phenomenon have been recently investigated by Dr. C. H. Edmondson (1929). This writer, after extended studies relative to ecologic factors and the growth and regeneration of the chelate appendages, concludes that "these two Hawaiian forms represent a single dimorphic species with variations ranging from the basic *Ortmannia* to the highly specialized *Atya*," and "by the law of precedence both should be included under the name *Atya bisulcata.*"

Earlier investigations of two forms of Atyidæ, collected within the shade of the same stone or tuft of grass in fresh-water streams and displaying distinctly different morphology of chelate appendages with individuals of intermediate character, have been described by Bouvier and Bordage. Dr. Calman (1910) has written a critical review of these researches, and bibliographies of the work are printed in his paper and that of Edmondson. In general, the generic distinctions of the forms referred to were assigned more for taxonomic clarity than as a final systematic allocation, although Bouvier (1925) gives them real generic status. Whether the two forms have been placed within the same species or in separate genera, the fact of their pronounced,

* "*Pycnactis, Mesactis*, and *Phaulactis*, gen. nov., and *Dinophyllum*, Linds," Ryder, T. A., Ann. & Mag. Nat. Hist. ser. 9, vol. xviii. pp. 385–401, pls. ix.–xii. (1926).

though limited, dimorphism has been interpreted in terms of evolutionary significance. The morphological differences have been characterized as variations, atavism from the more specialized to the more generalized form, and mutation (Calman, 1910, referring to Bouvier, and Edmondson, 1929). Dr. Edmondson finds that the two pairs of chelate appendages of young *Atya* tend to resemble those of *Ortmannia* before assuming the definitive *Atya* form; also that in a certain percentage of individuals regenerated appendages of *Atya* resemble those of *Ortmannia* and, *vice versa*, mutilated appendages of *Ortmannia* may regenerate to those of the *Atya* structure. The percentages are correlated somewhat with the age and development of the individual.

The basis for classification in *Atya bisulcata* and *Ortmannia henshawi* consists of the distinctions existing in the shape and proportions of the segments of the four chelipeds typical of each animal. *Atya* is somewhat larger than *Ortmannia*. These are differences which may be interpreted as belonging in the category of secondary sexual characters. The ecology of the two forms is apparently identical, and it is further noted that fully ninety per cent. of the group *Ortmannia* are males (distinguished by the modification of the first pair of swimmerets) and a similar percentage of the group *Atya* are females (Edmondson, 1929).

In order to investigate this clear suggestion to the effect that the major types of the two forms are but expressions of the sexual dimorphism existing in a single species, the writer is attempting to trace the germ-cell cycle of *Atya*, *Ortmannia*, and the intermediate forms.

Fixed preparations of adult male *Ortmannia henshawi* occasionally display ova of advanced development within the germinal epithelium of the testis in company with metamorphosed sperm (Pl. XIII. figs. 1 & 2). Ten specimens of males showing intermediate characters all possessed ova. In one of the latter the gonad of one side contained nothing but ova, somewhat subnormal in appearance, and that of the opposite side of the individual held sperm normal in appearance. The presence of ova and accompanying female secondary sexual characteristics in the testes of male diœcious crustaceans, as well as in many other groups, has been described frequently. Geoffrey Smith (1909) notes the presence of ova during non-breeding seasons in the young males of the Amphipod genus *Orchestia* and relates them to the condition of general anabolic metabolism in the animal. He states that this hermaphroditism is lost during periods of sexual activity. Boulenger (1908) reports that a great

majority of the young males of *Orchestia deshayesii* examined contained ova in the testes, but that ova in fully matured males were of rare occurrence.

It is reasonable to presume that the development of germ-cells bears a correlation with body-metabolism, and that during periods of metabolic activity relative to intense soma-construction—immaturity, regeneration, and intervals between reproductive periods—the sexual organization may become less decided than that which is typical of individuals prepared for reproductive activity. From phenotypic evidence, the reproductive elements of some forms of animals are more plastic or unstable than of others, *i. e.*, maleness and femaleness approach a balance whereby a relatively slight influence may direct a germ-cell from one sex to another at some *critical* period of its development. A condition of this sort is likely to influence the phenotype of characters of secondary sexual order to the extent of being intermediate between the two sexes or even characteristic of the opposite sex. It is one which should be taken into consideration in the taxonomic ratings of forms bearing contrasting characters as limited as those of the two types under discussion.

From the evidence listed above—*i. e.*, identical ecologic niche, disparity of sexes within a single form, limited morphological characteristics for classification, and mixed germinal elements in the gonads,—I believe there is reason to suggest that the Hawaiian types of *Atya bisulcata* and *Ortmannia henshawi* refer to a single sexually dimorphic species.

A definite count of the chromosome number of the intermediate forms is difficult to ascertain, but an effort is being made to obtain this information in addition to the cytological history of the germ-cells.

Literature Cited.

Boulenger, C. L. 1908. On the Hermaphroditism of the Amphipod *Orchestia deshayesii*, Audouin." Proc. Zool. Soc. London, 1908, vol. i. pp. 42–47.

Bouvier, E. L. 1925. "Recherches sur la morphologie, les variations, la distribution géographique des Crevettes de la famille des Atyidés." Encyclopédie Entomologique, ser. A, iv. pp. 1–379.

Calman, W. T. 1910. "The Researches of Bouvier and Bordage on Mutations in Crustacea of the Family Atyidæ." Quart. Journ. Micr. Sci. vol. lv. n. s. pp. 785–797.

Edmondson, C. H. 1929. "Hawaiian Atyidæ." Bernice P. Bishop Museum Publication, Honolulu. Bulletin no. 66.

Smith, Geoffrey. 1909. "Crustacea" in the 'Cambridge Natural History,' vol. iv. chap. iv. p. 104.

EXPLANATION OF PLATE XIII.

Fig. 1. A photo-micrograph of a section of the testis of a male *Ortmannia henshawi*, showing a well-developed ovum and metamorphosed spermatocytes. Note that the sperms show radiating processes. Magnification approximately × 619.

Fig. 2. From a section of the testis of a male *Atya henshawi*, showing two ova with spermatocytes in different stages of metamorphosis in the same field. Magnification approximately × 233.

XXXVII.—*Some* Heterakidæ *and* Oxyuridæ [*Nematoda*] *from Queensland.* By H. A. BAYLIS, M.A., D.Sc.

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THE species described in the present paper form part of the helminthological collection of the Australian Institute of Tropical Medicine, Townsville, North Queensland, and for the privilege of studying them the writer is indebted to Dr. G. M. Heydon.

Co-types of the species described as new will be deposited in the British Museum (Natural History) and in the School of Public Health and Tropical Medicine, Sydney, N.S.W.

Family **Heterakidæ.**

Subfamily *HETERAKINÆ.*

Spinicauda australiensis, sp. n. (Figs. 1 & 2.)

This species was collected on several occasions by Dr. W. Nicoll and Mr. J. W. Fielding from the rectum of *Tiliqua scincoides* at Townsville and Ching Do.

The males measure 3·8–3·9 mm. in length, the females 4·4–4·8 mm. The maximum thickness of the male is 0·36–0·38 mm., that of the female about 0·48 mm. The cuticle is transversely striated at intervals of about 2·5–3·75 μ. The lips are retractile within a cuticular collar. The œsophagus, measured from the anterior extremity and including the posterior bulb, measures 0·7–0·75 mm. in length in the male and 0·8 mm. in the female. At its anterior end there is a short pharynx measuring 0·06–0·07 mm. in length. The transverse diameter of the bulb is 0·15–0·2 mm. The nerve-ring is situated at 0·26–0·3 mm., and the excretory pore at 0·28–0·35 mm. from the anterior end.

Fig. 1.

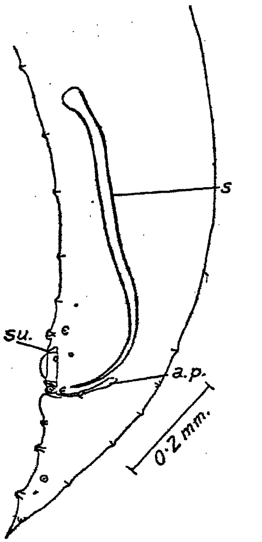
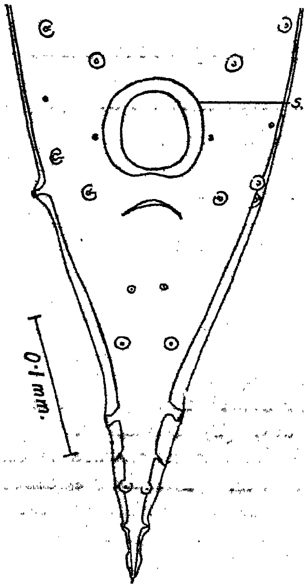


Fig. 2.



Spinicauda australiensis.

Fig. 1.—Posterior end of male; lateral view. *a.p.*, accessory piece; *s.*, left spicule; *su.*, sucker.

Fig. 2.—Posterior end of male; ventral view. *su.*, sucker.

The tail is conical and rapidly tapering in both sexes. In the male it is 0·21–0·27 mm. long. The chitinoid ring of the preanal sucker measures 0·07–0·08 mm. in diameter. The spicules are 0·6–0·65 mm. long, and the accessory piece 0·13–0·14 mm. The caudal papillæ number at least 23 pairs. Their arrangement is shown in figs. 1 & 2.

The tail of the female is 0·45–0·55 mm. long. The vulva is slightly in front of the middle of the body (at 2·1 mm. from the anterior end in a specimen 4·4 mm. long). The vagina runs posteriorly from it. The eggs have thick roundish-oval shells, with a granulated surface, and measuring 0·075–0·08 mm. × 0·053–0·06 mm. Their contents are segmenting *in utero*.

This form differs from all the described species of *Spinicauda*, except *S. longispiculata*, Baylis, 1929, in the great length of the spicules of the male. In *S. longispiculata*, a species recorded from *Gekko gecko* in Java, the spicules measure 0·625–0·68 mm., but the worms are nearly twice as large as the present specimens, and there are many other morphological differences.

Subfamily SUBULURINÆ.

Subulura peramelis, sp. n. (Figs. 3–5.)

This species was collected from the stomach (?) of a bandicoot (*Perameles obesula*) at Rollingstone, North Queensland, 24. 9. 15, by Dr. W. Nicoll. The following description is based on two males and three females.

The male measures 7·7–9·2 mm. in length, the female 11–12·75 mm. The maximum thickness (a little behind the œsophagus) in the male is 0·3–0·33 mm., in the female 0·35–0·4 mm. The cuticle is transversely striated at intervals measuring up to about 3·75 μ in both sexes. The mouth-aperture (fig. 4) is circular, and is supported by twelve lip-like structures. These are alternately (1) elongate and rectangular and (2) broadly triangular in outline. Two of the rectangular structures are lateral and carry the lateral cephalic papillæ. The four submedian papillæ are carried by four of the triangular structures.

The buccal capsule (fig. 3) is thin-walled and measures 0·05–0·0625 mm. in length and 0·045–0·055 mm. in maximum width (near its base). At its base, projecting into its cavity from the entrance to the œsophagus, there are six teeth, alternately large and small. The large teeth are [illegible]-like, the small teeth apparently bilobed.

Fig. 3.

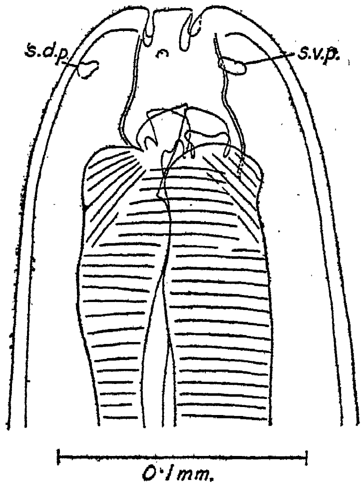
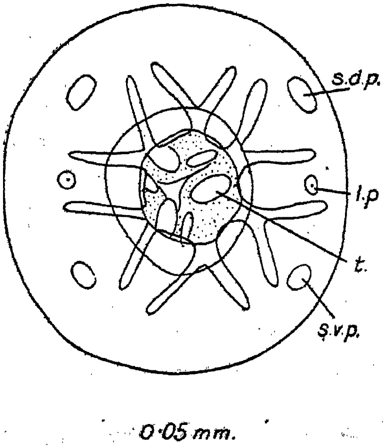


Fig. 4.



Subulura peramelis.

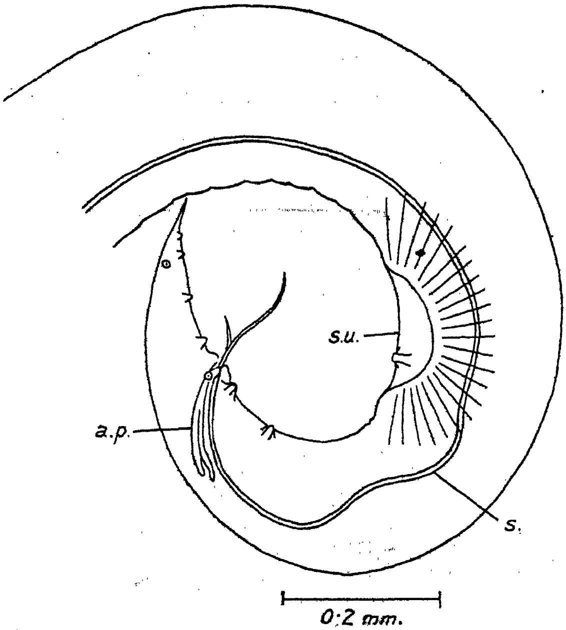
Fig. 3.—Anterior end of female; lateral view. *s.d.p.*, subdorsal papilla; *s.v.p.* subventral papilla.

Fig. 4.—Anterior end of male, viewed *en face*. *l.p.*, lateral papilla; *s.d.p.*, subdorsal papilla; *s.v.p.*, subventral papilla; *t.*, tooth.

The œsophagus (including the posterior bulb, and measured from the extremity of the head) is about 1·5 mm. long in the male and 1·55–1·8 mm. in the female. The bulb measures 0·21–0·25 mm. in length and 0·21–0·27 mm. in width. The nerve-ring is situated at about 0·35–0·45 mm., and the excretory pore at 0·52–0·82 mm., from the anterior extremity.

The tail of the male is about 0·2 mm. long, and is sharply pointed. There are ten pairs of caudal papillæ (fig. 5) and

Fig. 5.



Subulura peramelis. Posterior end of male; lateral view.
a.p., accessory piece; *s.*, left spicule; *su.*, sucker.

probably also a median papilla on the anterior lip of the cloaca. The most anterior pair of preanal papillæ is situated at the level of the sucker, and there are two more pairs of subventral papillæ between the sucker and the cloaca. At the level of the cloaca there are two pairs of sublateral papillæ. Behind the cloaca there are four subventral pairs and one subdorsal. The spicules measure 2–2·2 mm. in length, and the accessory piece 0·15–0·17 mm.

The tail of the female tapers rather gradually to a conical point, and is without a terminal spike. It measures 0·4–0·56 mm. in length. The vulva is situated at 4·5–5·2 mm. from the anterior end. The eggs are subglobular, with a maximum diameter of 0·0675–0·0875 mm., and contain embryos *in utero*.

This is apparently the first species of *Subulura* to be recorded from a Marsupial. It is quite a typical member of the genus (which is a very uniform one), except perhaps in the elaboration of the lip-like structures surrounding the mouth and in the reduplication of the teeth (three being the number usually described) at the base of the buccal capsule.

Family **Oxyuridæ**.

Subfamily *Oxyurinæ*.

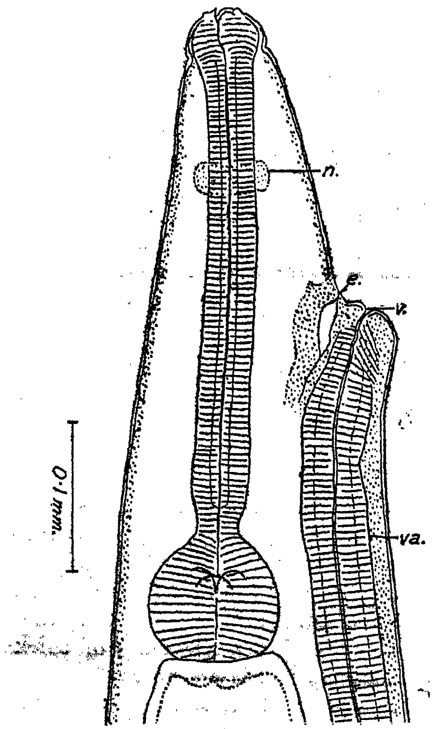
Parathelandros mastigurus, gen. et sp. n. (Figs. 6–9.)

This species was collected from the tree-frog, *Hyla cærulea*, in the Townsville neighbourhood on various occasions by Dr. W. Nicoll and Mr. F. H. Taylor. Dr. Nicoll gives the habitat as the rectum, Mr. Taylor as the small intestine. Dr. Nicoll also obtained the species from the rectum of *Hyla gracilenta*.

The total length of the male is 1·3–1·45 mm. and that of the female 3·24–4·72 mm. The maximum thickness, measured dorso-ventrally, is about 0·14 mm. in the male and 0·22–0·36 mm. in the female. Measured from side to side, and including the lateral alæ, the maximum thickness of the male is about 0·19 mm. and that of the female up to 0·38 mm. (All these measurements of thickness have probably been somewhat increased by cover-glass pressure). The cuticle of the body is transversely striated at intervals of about 3·75 μ in the male and about 7·5 μ in the female. These intervals, however, are subdivided by finer striations. In both sexes there are well-developed lateral alæ, extending throughout almost the whole length of the body. These terminate posteriorly at about the level of the anus in the female, and a little behind the cloaca in the male. They are particularly prominent in the male, especially towards the posterior end of the body. In both sexes the tail tapers rapidly for a short distance behind the anus, and then is produced into a long filament which tapers very gradually to an extremely slender point.

There are three lips, which are usually tightly closed together, so that their structure is not readily seen. In specimens in which they are open, it can be observed that each lip bears on its inner surface two flattened, triangular, sharply pointed, and anteriorly directed processes. On its outer surface each lip carries two papillæ, those of the dorsal

Fig. 6.



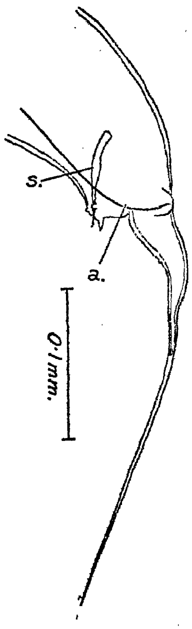
Parathelandros mastigurus. Anterior end of female; lateral view. *e.*, excretory pore; *n.*, nerve-ring; *v.*, vulva; *va.*, vagina.

lip being large and equal, while each ventro-lateral lip has one large and one small papilla. The œsophagus, including the posterior bulb, is 0·24–0·25 mm. long in the males (0·35 mm. in the only male from *Hyla gracilenta*), and 0·44–0·5 mm. in the females. The width of the bulb is 0·06–0·07 mm. in the male and 0·1–0·11 mm. in the female. The nerve-ring is situated at about 0·1 mm. from the anterior

end in the male (0·15 mm. in that from *Hyla gracilenta*), and 0·125–0·187 mm. in the female. The position of the excretory pore, in the male, is uncertain. In the female (fig. 6, *e.*) it lies immediately in front of the vulva, between the nerve-ring and the œsophageal bulb.

In the male, as has been stated, the lateral alæ (figs. 7 & 8, *a.*) extend a little behind the cloaca. Beyond the alæ the tail is produced into a filament measuring 0·27–0·32 mm. in

Fig. 7.



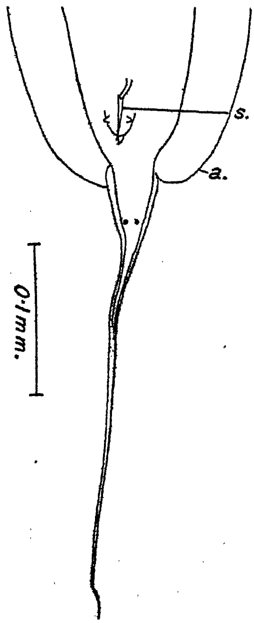
Parathelandros mastigurus. Posterior end of male; lateral view. *a.*, ala; *s.*, spicule.

length. The cloacal aperture is situated on a somewhat conical prominence, and its posterior lip bears a median projection. On the anterior surface of the cloacal prominence, and projecting somewhat laterally, there is a pair of small papillæ. Another pair of very small papillæ is situated ventrally at some distance behind the cloaca, on the basal portion of the tail-filament. There is a single spicule (figs. 7 & 8, *s.*), of a brownish colour and tapering to a sharp

point. It measures about 0·075 mm. in length. There appears to be no accessory piece.

The tail of the female (fig. 9) (measured from the anus) is 0·9–1·1 mm. long. The vulva (fig. 6, *v.*) is situated at 0·16–0·22 mm. from the anterior extremity of the body, considerably in front of the œsophageal bulb. It is extremely

Fig. 8.

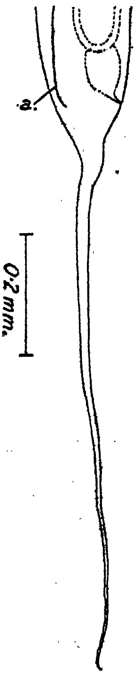


Parathelandros mastigurus. Posterior end of male; ventral view. *a.*, ala; *s.*, spicule.

prominent, causing a sudden increase in the diameter of the body at this point, and its opening is directed anteriorly. The vagina is stout and muscular, running posteriorly in close connection with the ventral body-wall for some distance, and then widening into a somewhat club-shaped chamber with thick, glandular walls. The whole organ measures about 0·75–1·2 mm. in length. Behind the glandular chamber the two uterine branches are given off. One of these runs posteriorly and passes into an oviduct and ovary whose coils lie in the hinder region of the body-cavity,

The other almost immediately turns forward, and the coils of its ovarian tube occupy an anterior position, somewhat behind the œsophageal bulb. The eggs are of elongate, almost fusiform, shape, with the shell somewhat flattened

Fig. 9.



Parathelandros mastigurus. Posterior end of female; lateral view.
a., ala.

on one side and slightly thickened at one pole, and measure 0·127–0·15 mm. × 0·037–0·047 mm. Their contents undergo segmentation *in utero.*

The following is a brief diagnosis of the new genus:—

PARATHELANDROS, gen. nov.

Oxyuridæ (Oxyurinæ): Lips bilobed. Buccal capsule absent. Œsophagus with small subglobular pharyngeal portion and well-developed posterior bulb. Lateral alæ present in both sexes.

Tail of male produced into a long and slender filament. Two pairs of caudal papillæ present, one of which is situated on the ventral surface of the caudal process, the other immediately in front of the cloaca. A single spicule present. Accessory piece absent. Tail of female rather suddenly constricted behind the anus to form a long slender filament. Vulva in œsophageal region, very prominent. Uterine branches almost directly opposed. Eggs elongate, not containing embryos when laid.

Hab. Alimentary canal of tree-frogs.

Genotype: *P. mastigurus*, sp. n.

This form appears to be very closely related to *Thelandros*, Wedl, 1862 (see diagnosis given by Baylis and Daubney, 1926, p. 24), the chief differences being found in the structure of the caudal end of the male and in the position of the vulva and arrangement of the genital tubes in the female.

Pharyngodon hindlei, Thapar, 1925.

Specimens collected on several occasions by Dr. W. Nicoll at Townsville and Ching Do, North Queensland, from the rectum of the Blue-tongued Lizard (*Tiliqua scincoides*), are referred to this species. Thapar (1925) records the host of his specimens as *Tiliqua* "*senicordis*," but this would appear to be a printer's error for *scincoides*. No locality is mentioned. The present material agrees very well with Thapar's description, except that the spicule described by him as existing in the male has not been made out. There is, however, a conical prolongation of the cloaca, supported by a structure which is probably that interpreted by Thapar as a spicule.

Pharyngodon tiliquæ, sp. n. (Fig. 10.)

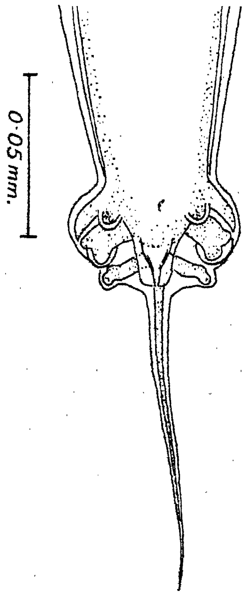
This form was collected on several occasions at or near Townsville, North Queensland, by Dr. W. Nicoll, Mr. J. W. Fielding and Mr. F. H. Taylor, from the rectum of the Blue-tongued Lizard (*Tiliqua scincoides*).

Males measure 1·8–1·9 mm. in length, females 2·65–3·2 mm. The maximum thickness (under cover-glass pressure) is 0·11–0·15 mm. in the male and 0·2–0·25 mm. in the female. The transverse striations of the cuticle are very fine and faint in the male. In the female they are inconspicuous anteriorly, but behind the vulva become rather prominent annular thickenings at intervals of about 12·5 μ.

The lateral alæ, in both sexes, are narrow, beginning about [illegible] between the œsophageal bulb and the excretory

pore, or a little behind this point. The diameter of the head is about 0·015–0·02 mm. in the male and 0·03 mm. in the female. The œsophagus, measured from the anterior extremity and including the posterior bulb, is 0·35–0·37 mm. long in the male and 0·43–0·5 mm. in the female, or about one-sixth of the total length of the body. The transverse diameter of the œsophageal bulb is 0·06–0·07 mm. in the male and 0·105–0·115 mm. in the female. The nerve-ring is situated at 0·14–0·17 mm., and the excretory pore at 0·64–0·73 mm., from the anterior end. The excretory pore has within its posterior border a fringe of slender cuticular processes.

Fig. 10.



Pharyngodon tiliquæ. Posterior end of male; ventral view.

In the male the caudal end (fig. 10) is provided with the bursa-like membrane characteristic of the genus, behind which the tail is prolonged as a slender tapering filament about 0·1 mm. in length. The usual three pairs of papillæ are present. Those of the posterior postanal pair are included in the "bursa." Those of the anterior postanal pair are stout and somewhat bifurcated. The preanal pair are sessile. Arising near the bases of these are a pair of lateral processes,

which appear to be supports for the "bursa" rather than papillæ. No spicule has been made out, but the prolongation of the cloaca appears to be provided with a supporting structure which might be mistaken for a spicule, as in the case of *P. hindlei.*

In the female the tail is 0·59–0·75 mm. in length, and tapers to a long slender filament, without spines. The vulva is situated almost immediately behind the excretory pore. The vagina is stout and muscular, and runs posteriorly from the vulva. The eggs are relatively enormous, with thin shells measuring, on an average, 0·14 mm. × 0·06 mm. Their contents are unsegmented *in utero.*

Of the described species of *Pharyngodon*, this form appears to approach most closely to *P. inermicauda*, Baylis, 1923. It differs from this species, however, in many respects, especially in the relatively small width of the lateral alæ in the male. A useful table and key to the species of *Pharyngodon* have been given by Spaul (1926). These include all the species known up to the present except *P. batrachiensis*, Walton, 1929, which is known from females only, and occurs in tadpoles of *Rana pipiens.*

References.

Baylis, H. A. 1923. "Report on a Collection of Parasitic Nematodes, mainly from Egypt.—Part II. Oxyuridæ." Parasitol. xv. pp. 14–23.

——. 1929. "Some new Parasitic Nematodes and Cestodes from Java." Parasitol. xxi. pp. 256–265.

Baylis, H. A., & Daubney, R. 1926. 'A Synopsis of the Families and Genera of Nematoda.' London (British Museum (Nat. Hist.)).

Spaul, E. A. 1926. "On a new Species of the Nematode Genus *Pharyngodon*." Ann. & Mag. Nat. Hist. (9) xvii. pp. 585–591.

Thapar, G. S. 1925. "Studies on the Oxyurid Parasites of Reptiles." Journ. Helminthol. iii. pp. 83–150.

XXXVIII.—*Notes on the Cephalopoda.*—No. 12. *Observations on young Octopods obtained by the 'Dana' Expedition.* By G. C. Robson, M.A.

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By the courtesy of Prof J. Schmidt (Leader of the 'Dana' Expedition) and Prof. L. Joubin I am enabled to publish the following observations upon specimens obtained by Prof. Schmidt in the N. Atlantic and E. Pacific.

The young examples of Octopods submitted to me are probably referable to five species. I can identify none of them with any known adult form, though I think numbers 2 and 3 may be referable to *Octopus rugosus*. It is possible to be more certain as to no. 5, though the specific identity is not clear. There is a great dearth of knowledge of the young stages of even the commonest species of *Octopus*, and, until we can build up good developmental series, it seems to me the best thing to describe as many forms as possible in order to accumulate data on the subject.

1. *Octopus* sp. juv.

Two specimens from 'Dana' Station 1105 (100 m. wire), N. of Bermuda.

Dimensions (in mm.).

Mantle		7·5×5·2
Head, width		5
Arms:	R. 1	7
	2	8
	3	8
	4	7
Web, maximum		?2·7

The suckers are of moderate size. The chromatophores are highly characteristic. There are only two rows up each arm, the intercotyledonary row being absent. There are none on the dorsum, save two very large ones at the apex. There are, however, four ventral transverse rows. The eyes are surrounded by gold tissue. The surface is covered by well-marked tubercles. These might be young *Bathypolypus arcticus*.

2. *Octopus* sp.

Two specimens from 'Dana' Station 1314 (600 m. wire), Caribbean Sea.

Three specimens from 'Dana' Station 1293 (600 m. wire), Caribbean Sea.

One specimen from 'Dana' Station 1285 (600 m. wire), near Barbuda.

One specimen from 'Dana' Station 1273 (700 m.), near Barbuda.

These seven examples seem to be all referable to the same species, but that from Station 1285 is very much distorted.

These are very small squat forms with finer sculpture than that seen in no. 1. There are two rows of chromatophores up the arms; chromatophores also occur on the head and the

dorsum of the mantle, more sparsely on the ventral surface. The circum-ocular gold patches are more extensive, and there is a strong gold flush on the dorso-lateral surfaces. This may be a nearly stage of 1; but I think it is distinct.

3. *Octopus* sp. juv.

One specimen from 'Dana' Station 1281 (300 m.), Caribbean Sea.

One specimen from 'Dana' Station 1279 (300 m.), Caribbean Sea.

These are characterized by their rather oblong mantle, longish arms, and the absence of chromatophores on the body. The eye is surrounded by gold tissue. The surface is covered with obscure pustules.

Dimensions (Stn. 1279) (in mm.).

Mantle	7×5
Head	4·8
Arms: R. 1	8·5
2	10
3	11
4	8·5
Web, maximum depth	3

The web is subequal; the suckers are small and rather widely spaced. There are two rows of dark chromatophores up each arm.

4. *Octopus* sp. juv.

One specimen from Station 1341 (150 m.), S. of Bermuda.

Dimensions (in mm.).

Mantle	8·7×6
Head, width	6·3
Arms: R. 1	7·5
2	8·5
3	7·0
4	6·2
Web, maximum depth	3

The web is subequal. The proximal suckers are very large and close together. There are two rows of strongly marked chromatophores up each arm. The two dorsal rows meet at the base of the arms (this is not found in no. 3). There are a few chromatophores on the dorsum and sides. The eyes are surrounded by gold tissue, as usual. I think this specimen must be regarded as quite smooth. This character, the large suckers, squatter shape, and disposition of the chromatophores distinguish it from no. 3.

5. *Octopus* sp.

One example (♀) from Station 1206 (just west of Panama) in 1200 m. (wire).

Dimensions (in mm.).

Mantle: length	19
" width, % length	63 %
Head width, % mantle length	52 %
Arms: R. 1	28
2	31
3	28
4	27
Web: A	7·5
B	8·3
C	9·5
D	8·5
E	5·5
Web depth, % longest arm	30 %
Longest arm, % total length	62 %

The mantle is rather narrowly ovoid, the head somewhat narrower than the body. The arms are short and subequal. The web has the pattern C.D.=B.A.E. and is of moderate length (30 %). The suckers are close-set and very prominent. The funnel is short and broad, and the siphonal notch very deep and arched. The funnel-organ is double, the outer limbs being shorter than the inner. The gill is remarkable among all the Octopods known to me, as it has about fifteen filaments in each demibranch, *i. e.*, more even than those found in *Macroctopus* (Robson, 1929, pp. 173, 174). The ink-sac is present and well-developed. The skin is quite smooth. The colour is very characteristic. The mantle is thickly covered dorsally and ventrally with large and small reddish brown chromatophores. There is, as in most young forms, an intercotyledonary series up the arms on each side, but, in addition, the dorsum of at least the first two arms is occupied by an irregular mass of chromatophores. On the ventral arms these partake more of the juvenile arrangement (*i. e.*, two axial rows). The most striking feature, however, is that the head is completely encircled in its ventral circumference by a bright mass of gold tissue. This also surrounds the eyes, but becomes more obscure between them. This golden tissue is spread over the web and continued up the proximal portion of each arm. There is a slight golden glow on the dorso-lateral surface of the mantle. The whole appearance of the animal is most striking.

I have been unable to identify this form with any known species from the E. Pacific. The highly developed and characteristic gold tissue on the head and arms is quite unique. I have noticed gold iridescence in other young forms. It seems to be well developed on the dorsal mantle in the ambiguous *Octopus venustus*, Rang, and is possibly indicated in "*Polypus* juv." (Berry, 1912, p. 289) from Monterey Bay. I have never seen the gold iridescence persisting in any adult, though local patches of iridescent tissue are found, *e.g.*, in *Octopus areolatus, ocellatus*, etc. This form, which is obviously still somewhat immature, seems allied to the group of *Octopus pallida* (Robson, *l. c.* p. 126), and may be near Berry's *Octopus californicus*, from which it differs in various important features. It is to be noted that the latter has been recorded (at least tentatively) from over 1000 fathoms by Berry.

BIBLIOGRAPHY.

ROBSON, G. C. 1929. "A Monograph of the Recent Cephalopoda," Part I. British Museum (London).

BERRY, S. S. 1912. Bull. Bureau Fisheries, Washington, D.C. vol. xxx. (1910), p. 269.

XXXIX.—*New or little-known* Tipulidæ (*Diptera*).—XLV. *Australasian Species*. By CHARLES P. ALEXANDER, Ph.D., F.E.S., Massachusetts Agricultural College, Amherst, Massachusetts, U.S.A.

IN the present report I wish to discuss part of a series of Victorian Eriopterine crane-flies belonging to the great genus *Molophilus*, Curtis. The entire series was taken by my friend, Mr. F. Erasmus Wilson, to whom my deepest thanks are extended and to whom the types have been returned.

Molophilus janus, sp. n.

Belongs to the *plagiatus* group; general coloration brownish grey; head chiefly yellow, the centre of the vertex infuscated; antennæ (♂) of moderate length, extending to shortly beyond the wing-root; segments of legs pale, the tips of the femora and tibiæ narrowly darkened; male hypopygium with the inner dististyle elongate, the base a sinuous blade, the distal third narrowed into a curved blackened

Male.—Length about 3·5–4 mm.; wing 4·5–5·2 mm.

Female.—Length about 4·2 mm.; wing 5 mm.

Rostrum and palpi dark brown. Antennæ (♂) of moderate length, if bent backward extending to shortly beyond the wing-root; flagellar segments oval, with a conspicuous erect white pubescence; antennal scape obscure yellow; flagellum dark brown. Anterior vertex, orbits, and occiput yellow, the centre of the vertex extensively brown.

Pronotum dark; anterior lateral pretergites china-white. Mesonotal præscutum with three greyish-brown stripes, the restricted interspaces and lateral margins more buffy; scutal lobes chiefly greyish brown, sparsely variegated with obscure yellow, including the posterior callosities; scutellum obscure yellow; postnotum grey. Pleura chiefly dark greyish brown, the dorso-pleural region pale; dorsal sternopleurite and pteropleurite more reddish brown. Halteres whitish. Legs with the coxæ brownish testaceous; trochanters pale yellow; femora pale yellow, the tips conspicuously blackened; tibiæ pale yellow, the tips narrowly infuscated, the bases more vaguely darkened; fore tibiæ (♂) with a distinct subbasal black ring; tarsi pale brown, passing into black at tips; terminal tarsal segment dilated outwardly, the apex truncate. Wings whitish, the macrotrichia pale brown; veins only a little darker than the ground-colour. Venation: R_2 lying just before the level of *r–m*; petiole of cell M_3 short, about one-half longer than *m–cu*; vein *2nd A* long, ending shortly beyond the base of the petiole of cell M_3.

Abdomen dark brown, the large hypopygium obscure yellow. Male hypopygium with the apical beak of the basistyle very small, triangular. Both dististyles placed close together in the notch of the basistyle. Outer dististyle with the stem relatively slender, gently arcuated, the apex expanded and darkened, the two arms subequal in length, separated from one another by a large notch. Inner dististyle approximately one-third to one-half longer than the outer, appearing as a sinuous, irregular, flattened pale blade, the distal third to fourth narrowed into a curved black hook; margin of style near base conspicuously dilated. Ædeagus long and slender, in slide-mounts extending caudad to the apex of the basistyle.

Hab. Victoria.

Holotype, ♂, Bogong High Plains, altitude 5600–6000 feet, January 1928 (*F. E. Wilson*).

Allotopotype, ♀.

Paratopotypes, 6 ♂ ♀, 4 being from the "Little Plain" (see Ann. & Mag. Nat. Hist. (10) iii. p. 327, 1929).

Molophilus titania, sp. n.

Belongs to the *plagiatus* group; head dark; antennæ (♂) elongate; general coloration fulvous-yellow, the pleurotergite darkened; legs black, handsomely banded with china-white; wings creamy, indistinctly variegated with pale brown; abdomen yellow, the terminal segments in both sexes blackened.

Male.—Length about 3–3·2 mm.; wing 4·2–4·3 mm.

Female.—Length about 3·2–3·4 mm.; wing 4–4·2 mm.

Rostrum and palpi black. Antennæ (♂) elongate, if bent backward extending to some distance beyond the base of the abdomen, dark brown, the basal segments more bicolorous, the proximal ends dark, the apices paler; flagellar segments elongate-fusiform, producing a nodulose appearance, each segment provided at widest part with a whorl of long pale verticils. Head chiefly dark brown.

Pronotum and anterior lateral pretergites light sulphur-yellow. Mesonotum fulvous-yellow, the humeral region of præscutum sulphur-yellow. Pleura pale yellow, the pleurotergite infuscated. Halteres pale, the knobs light sulphur-yellow. Legs with the coxæ pale yellow; trochanters brownish yellow; femora black, with a conspicuous china-white subterminal ring, this narrower than the black apex, on the middle femora very narrow; tibia black with a broad white medial ring, this broadest on the posterior tibiæ; tarsal segments 1 and 2 white, the tips narrowly blackened; remaining tarsal segments uniformly blackened; a differentiated subbasal ring on fore tibia of male scarcely evident. Wings with the ground-colour creamy, indistinctly variegated with pale brown, this colour including the broad apex, a band along the cord, and clouds on the basal third of the wing; veins pale, slightly darker in the clouded areas; macrotrichia dark. Venation: vein *2nd A* relatively long, ending shortly beyond the origin of the petiole of cell M_3, the cell narrowed on outer half.

Abdomen yellow, the terminal segments, including the genitalia of both sexes, blackened. Ovipositor with the valves dark horn-colour. Male hypopygium relatively small. Basistyle with the apical beak unusually small and slender. Outer dististyle very short-stemmed, the two arms blackened, subequal in length, the outermost a little stouter and more pointed. Basal dististyle only feebly chitinized, appearing as a short stout lobe, broadest at base, obtuse at apex, the entire surface densely set with long conspicuous setæ.

Phallosomic structure a long-rectangular plate, parallel-sided, the apex obtusely convex. Ædeagus elongate, approximately three times the length of the basal dististyle.

Hab. Victoria.

Holotype, ♂, Ben Cairn, near Millgrove, in beech-gully, altitude 2900–3200 feet, February 9, 1929 (*F. E. Wilson*).

Allotopotype, ♀.

Paratopotypes, 3 ♂ ♀.

"Found at the head of a beech (*Nothofagus Cunninghamii*, Hook. f.) gully where they were found resting on the fronds of low-growing ferns. Within a few yards of their habitat I took a male *Thaumatoperla*."—*F. E. Wilson.*

Molophilus titania is one of the most beautiful and distinct species of the genus so far discovered.

Molophilus perluteolus, sp. n.

Belongs to the *plagiatus* group; general coloration very pale yellow; antennæ of moderate length only; male hypopygium with the basal dististyle a nearly straight black rod, the tip curved and weakly bidentate.

Male.—Length about 3–3·4 mm.; wing 3·8–4·2 mm.

Female.—Length about 3·5 mm.; wing about 4 mm.

Rostrum and palpi pale reddish yellow, the outer segments of the latter darkened. Antennæ (♂) of moderate length, if bent backward extending about to the wing-root; scapal segments reddish yellow; flagellum pale, the segments with long verticils. Head pale yellow.

Thorax entirely pale yellow, unmarked. Halteres and legs pale yellow, the outer tarsal segments weakly infuscated; fore tibiæ (♂) with a narrow, very pale brown subbasal ring. Wings uniformly pale yellow, the veins only a trifle darker. Venation: R_2 lying just beyond the level of *r–m*; vein *2nd A* terminating opposite or just before *m–cu*.

Abdomen pale yellow, only the dististyli blackened. Male hypopygium with the beak of the basistyle very stout, blackened, its base surrounded by conspicuous setæ. Outer dististyle with the two arms unequal, the outer more flattened, its margin rounded and microscopically roughened; inner arm acute. Basal dististyle a nearly straight rod, heavily blackened except on basal fourth, the apex curved and weakly bidentate. Phallosomic structure an oval pale plate set with microscopic setulæ. Ædeagus elongate, exceeding the basal dististyle.

Hab. Victoria.

Holotype, ♂, Belgrave, in dark fern-gully, March 31, 1929 (*F. E. Wilson*).

Allotopotype, ♀.

Paratopotypes, 6 ♂ ♀.

Molophilus perluteolus is allied and generally similar to *M. bucerus*, Alexander, differing in its shorter antennæ and structure of the male hypopygium.

Molophilus flavidellus, sp. n.

Belongs to the *plagiatus* group; general coloration pale yellow; antennæ (♂) relatively elongate, the basal segments pale; wings light yellow; vein *2nd A* ending about opposite one-third the length of the petiole of cell M_3; male hypopygium with the basal dististyle a long straight rod that terminates in two or three weak denticles; phallosomic structure a pale oval cushion, its caudal end gently emarginate.

Male.—Length about 3·5–4 mm.; wing 4·2–5·3 mm.

Female.—Length about 4·5 mm.; wing about 6 mm.

Rostrum yellow; palpi light brown. Antennæ (♂) relatively elongate, if bent backward extending to about middistance between the origins of wings and halteres, pale yellow, the outer segments slightly darker; flagellar segments with long conspicuous verticils. Head light yellow.

Pronotum reddish yellow, paler laterally. Mesonotal præscutum light reddish yellow, the humeral region and pretergites light sulphur-yellow; scutal lobes reddish yellow, the median region and scutellum paler; postnotum reddish yellow. Pleura pale reddish yellow. Halteres pale, the knobs bright yellow. Legs with the coxæ and trochanters pale yellow; remainder of legs yellow, the outer tarsal segments darkened; fore tibiæ (♂) with a narrow brown subbasal annulus. Wings broad, light yellow, the veins a trifle darker; macrotrichia very pale brown. Venation: petiole of cell M_3 relatively short, about twice *m–cu*; vein *2nd A* long, ending about opposite one-third the length of the petiole of cell M_3.

Abdomen yellow, including the hypopygium. Male hypopygium with the beak of the basistyle relatively stout, the tip acute. Outer dististyle with the two arms unequal, the outer longest and more expanded, the inner arm shorter and subacute in lateral aspect. Basal dististyle a long, nearly straight rod, pale on more than the basal two-thirds, the tip darkened; apex of style with two or three weak denticles. Phallosomic structure a pale oval cushion, the

caudal end gently emarginate. Ædeagus long, pale, a little longer than the basal dististyle.

Hab. Victoria.

Holotype, ♂, Ben Cairn, near Millgrove, in beech-gully, altitude 2900–3200 feet, February 1929 (*F. E. Wilson*).

Allotopotype, ♀.

Paratopotype, ♂; *paratypes*, 2 ♂♂, Belgrave, in dark fern-gully, March 31, 1929 (*F. E. Wilson*).

Molophilus flavidellus is generally similar to *M. bucerus*, Alexander, differing especially in the structure of the male hypopygium.

Molophilus arcuarius, sp. n.

Belongs to the *plagiatus* group; general coloration fulvous to yellow; halteres and legs yellow, the terminal tarsal segments infuscated; wings yellow; male hypopygium with the basal dististyle a simple, gently arcuated rod that narrows to an acute point, the surface roughened, on lower face before apex forming a series of blunt teeth; phallosomic structure glabrous, widened outwardly, the caudal margin gently emarginate.

Male.—Length about 3·8 mm.; wing 5–5·2 mm.

Rostrum and palpi dark brown. Antennæ (♂) of moderate length, if bent backward extending to slightly beyond the origin of the wings; basal segments pale, the outer segments darker; flagellar segments with a very long erect white pubescence. Head yellow.

Pronotum brownish medially, obscure yellow behind; anterior lateral pretergites yellowish white. Mesonotum fulvous to obscure yellow, the pleura a little more testaceous. Halteres pale yellow. Legs with the coxæ and trochanters pale yellow; remainder of legs yellow, the outer tarsal segments infuscated; fore tibiæ (♂) with a rather extensive but little distinct pale brown subbasal enlargement. Wings yellow, the veins darker yellow; macrotrichia pale brown. Venation: R_2 nearly in alignment with *r–m*; vein *2nd A* relatively long, ending about opposite mid-length of the petiole of cell M_3.

Abdomen brownish yellow, including the hypopygium; tergites variegated laterally with darker brown. Male hypopygium with the beak of the basistyle slender, blackened. Outer dististyle with the stem slender, the arms large and conspicuous, both obtuse at tips. Basal dististyle a simple, gently arcuated rod that narrows to an acute tip, the basal third pale, the remainder dark; surface microscopically

roughened, before the apex on the inner face more accentuated into a comb of blunt teeth. Phallosomic structure pale, widened outwardly, the caudal margin gently emarginate, the surface entirely glabrous. Ædeagus straight, moderately long, slightly exceeding the basal dististyle.

Hab. Victoria.

Holotype, ♂, Ben Cairn, near Millgrove, in beech-gully, altitude 2900–3200 feet, February 9, 1929 (*F. E. Wilson*).

Paratopotypes, 2 ♂♂.

Molophilus arcuarius is readily told from the other similar regional pallid species by the structure of the hypopygium, especially the basal dististyle and phallosomic structure.

Molophilus strix, sp. n.

Belongs to the *plagiatus* group, *annulipes* subgroup; head ochreous; antennæ of moderate length; mesonotal præscutum with four brown stripes, the humeral region yellow; halteres with the knobs darkened; wings narrow, the veins seamed with brown; male hypopygium with the inner dististyle long, slender, the long straight apical point bent at a right angle to the remainder of the style; ventral lobe of basistyle without an apical beak, but provided with a dense brush of setæ.

Male.—Length about 3·4–4 mm.; wing 4·2 × 1 to 5 × 1·15 mm.

Female.—Length about 5 mm.; wing 6 mm.

Rostrum and palpi black. Antennæ of moderate length, if bent backward extending approximately to the wing-root; dark brown; flagellar segments long-oval, with a dense erect white pubescence; each segment with a long, unilaterally arranged verticil. Head ochreous, the centre of the vertex vaguely darkened.

Pronotum above pale brown. Anterior lateral pretergites pale whitish yellow. Mesonotal præscutum with four nearly confluent brown stripes, the humeral region pale yellow, the lateral margins less conspicuously so; pseudosutural foveæ and tuberculate pits black; scutum and scutellum grey, the scutal lobes variegated with dark brown; postnotum greyish brown. Pleura dark brown, narrowly striped longitudinally with obscure yellow; dorso-pleural region dark. Halteres yellow, the knobs infuscated. Legs with the coxæ and trochanters pale testaceous; femora brown, paler basally, with a barely evident pale subapical ring; tibiæ brown, fore tibiæ (♂) with a dilated but scarcely darker subbasal ring; tarsi dark, but clothed with abundant yellow setæ to

produce a whitish appearance. Wings narrow, with a brown tinge, especially noticeable as seams to the veins, the axillary region similarly darkened; a small darkened area in cell *Sc* near base, as in the subgroup; veins and macrotrichia dark brown. Venation: petiole of cell M_3 approximately twice the length of the oblique, gently arcuated *m–cu*; vein *2nd A* relatively short, ending before the level of the caudal end of *m–cu*; cell *2nd A* narrow.

Abdomen dark brown, including the hypopygium. Male hypopygium with the ventral lobes of the basistyle relatively slender, bearing at tip a dense brush of long yellow setæ, but not otherwise armed. Both dististyles placed close together. Outer dististyle shorter, the stem long and slender, pale, the two arms tumid, blackened, the outer arm obtuse, the inner arm more pointed. Inner dististyle longer, slender, sinuous, the apex bent nearly at a right angle and produced into a long, straight, acute point; just before this apical point, on outer face, with a small appressed spine. Phallosomic structure a very broad pale cushion. Ædeagus long and slender, a little shorter than the inner dististyle.

Hab. Victoria.

Holotype, ♂, Melton, May 27, 1928 (*F. E. Wilson*).

Allotype, ♀, Clarkefield, September 27, 1928 (*F. E. Wilson*).

Paratopotype, ♂; *paratypes*, 2 ♀♀, Quantong, September 3, 1928 (*A. D. Selby*); 6 ♂♀, with the allotype.

Despite the lack of an apical beak on the ventral lobe of the basistyle of the hypopygium, there can be little doubt that the present species is correctly placed in the *annulipes* subgroup.

Molophilus alpicola, sp. n.

Belongs to the *gracilis* group, *ruficollis* subgroup; antennæ short; mesonotal præscutum light reddish brown, the postnotum and pleura dark brown; halteres pale yellow; legs yellow, the tips of the femora and tibiæ narrowly infuscated; fore tibiæ (♂) with a conspicuous subbasal black ring; wings greyish, the cord conspicuously seamed with brown; male hypopygium with the basal dististyle a simple, powerful, blackened structure, the apex curved into a long stout spine.

Male.—Length about 4·8 mm.; wing about 5·4 mm.

Rostrum and palpi dark brown. Antennæ of moderate length, if bent backward ending a little before the wing-root,

dark brown throughout; flagellar segments long-cylindrical, the lower face of each slightly more protuberant, the outer face with verticils of moderate length. Head dark grey.

Pronotum dark brown; anterior lateral pretergites yellow. Mesonotum light reddish brown, the humeral region and lateral margins obscure yellow; posterior lateral callosities of scutal lobes and the scutellum obscure yellow; postnotum dark brown, sparsely pruinose. Pleura dark brown, the ventral sternopleurite more yellowish; pleurotergite chiefly pale and densely set with long pale setæ that arise from dark setigerous punctures. Halteres pale yellow. Legs with the coxæ yellowish testaceous; trochanters yellow; femora yellow, the tips narrowly infuscated; tibiæ yellow, the tips very narrowly and vaguely darkened; fore tibiæ (♂) with a narrow black subbasal ring at slightly more than its own length beyond the base; basitarsi yellow, the tips and remainder of tarsi passing into black. Wings of the type broken, one entirely lost, the other broken beyond the cord; general coloration greyish, the stigmal region more yellowish; a large and conspicuous dusky cloud on the anterior cord, together with a narrower and less evident darkening on the posterior cord; veins light yellow, darker in the infuscated areas. Venation: R_2 lying a short distance beyond the level of *r–m*: petiole of cell M_3 relatively short, about one-half longer than *m–cu*; vein *2nd A* elongate, gently sinuous, ending about opposite the fork of M_{3+4}.

Abdomen dark brown, including the hypopygium. Male hypopygium very short and broad. Ninth tergite with the caudal margin convexly rounded and here with a median group of setæ. Basistyle short and stout, the ventral lobe broad, densely provided with coarse setæ. Outer dististyle with the stem very slender, bearing a small lobule at base; distal half of style expanded into a blade that splits into two arms; outer arm slender, gently sinuous; inner arm with the basal half expanded into a conspicuous flange, the distal half slender. Basal dististyle a simple powerful blackened structure, the base stout, the apical third bent at more than a right angle into a long stout spine. No distinct phallosomic structure is apparent. Ædeagus long and slender, the basal third with conspicuous lateral flanges, the distal portion slender, in slide-mounts extending to beyond the level of the apex of the basal dististyle.

Hab. Victoria.

Holotype, ♂, Bogong High Plains, altitude 5600–6000 feet, January 1928 (*F. E. Wilson*).

Molophilus chloris, sp. n.

Belongs to the *gracilis* group, *ruficollis* subgroup; general coloration dark brown, the præscutum laterally more yellowish; femora dark brown, with a vague diffuse pale subterminal ring; wings greying, with a darker seam along the cord; male hypopygium with the inner dististyle a short, stout, blackened rod, more or less flask-shaped, at and near apex with two small spines.

Male.—Length about 3·8 mm.; wing 5 mm.

Rostrum and palpi black. Antennæ with the basal segments black, the flagellum broken. Head dark brown.

Mesonotal præscutum broadly dark brown medially, paling to ochreous-yellow on sides; humeral region and anterior lateral pretergites very pale yellow; scutal lobes darkened; scutellum brown, more yellowish caudally; postnotal mediotergite brownish black, more obscure laterally behind. Pleura chiefly dark brown, vaguely marked with paler. Halteres pale. Legs with the coxæ and trochanters obscure yellow; femora chiefly dark brown, with a vague and diffuse yellow subterminal ring; tibiæ dark brown; tarsi black. Wings greyish, the prearcular region more yellowish; a conspicuous greyish-brown seam along the cord, extending from the stigma to Cu_1; less distinct cloudings in cell *2nd A* and along the distal section of Cu_1; macrotrichia black. Venation: R_{2+3} about one-half longer than the basal section of R_5; vein *2nd A* elongate, gently sinuous, extending to opposite or beyond mid-length of the petiole of cell M_3.

Abdomen black, including the hypopygium. Male hypopygium with the basistyle short and stout, the ventral lobe short and broad, with conspicuous setæ. Both dististyles arising close together in the notch of the basistyle; outer dististyle longest, appearing as an angularly curved flattened blade that divides at apex into two long beak-like blades, both flattened and obtuse at tips. Inner dististyle short and stout, more or less flask-shaped, blackened, nearly straight, tapering gradually to the acute curved tip; before tip with a small lateral spine. Phallosome a pale depressed plate, with elongate darkened blades on either side. Ædeagus relatively short and stout, very wide at base.

Hab. Victoria.

Holotype, ♂, Belgrave, in dark fern-gully, January 13, 1929 (*F. E. Wilson*).

This very distinct species is named in honour of Miss Barbara Chloris Wilson, eldest daughter of F. Erasmus Wilson.

Molophilus tasioceroides, sp. n.

Belongs to the *gracilis* group, *ruficollis* subgroup; antennæ (♂) longer than the body; wings relatively narrow, tinged with dusky; male hypopygium with the inner dististyle shorter than the outer, extended into an acute straight spine; phallosomic structure heavily blackened, terminating in a small comb of from four to six teeth.

Male.—Length about 4–4·2 mm.; wing 4·8–5 mm.; antenna about 4·5–4·6 mm.

Rostrum and palpi black. Antennæ (♂) longer than the body; second scapal segment obscure yellow, the remainder of the organ black; flagellar segments elongate-cylindrical, with conspicuous erect verticils. Head dark greyish brown.

Mesonotum almost uniformly dark brown; humeral region of præscutum obscurely brightened; scutellum a little paler. Pleura testaceous-brown, the pteropleurite more yellowish. Halteres long, obscure yellow, the knobs infuscated. Legs with the coxæ and trochanters yellowish testaceous; femora yellowish brown, with dark setæ, the outer segments of the leg becoming darker brown. Wings relatively narrow, tinged with dusky, some of the veins narrowly seamed with still darker brown; veins brown, the macrotrichia darker. Venation: vein *2nd A* relatively short, ending some distance before the transverse *m–cu*.

Abdomen dark brown, including the hypopygium. Male hypopygium with the ninth tergite conspicuous, deeply emarginate, the lobes densely set with spinous setæ. Basistyle with the ventral lobe elongate, relatively slender. Both dististyles arising close together, the outer style very large, its stem short and stout, the two arms conspicuously unequal in size; outer arm considerably longer than the stem, flattened; inner arm about one-half this length, the tip obtuse. Inner dististyle shorter than the outer, appearing as a simple rod that terminates in an acute straight spine; at near mid-length the style is expanded into a flange that bears about four setigerous punctures, in addition to a dense cushion of small erect setæ on face of expanded portion of style. Phallosomic structure heavily blackened, terminating in a small crown of from four to six teeth, these varying from short to longer. Ædeagus slender, pale yellow, subtended by a flange on its basal three-fourths.

Hab. Victoria.

Holotype, ♂, Belgrave, in dark fern-gully, altitude 900 feet, June 4, 1928 (*F. E. Wilson*).

Paratopotypes, 5 ♂ ♂.

Molophilus tasioceroides bears a rather conspicuous resemblance to a large species of *Tasiocera*.

Molophilus extricatus, sp. n.

Belongs to the *gracilis* group and subgroup; general coloration reddish brown; head dark grey, the posterior orbits more yellowish; wings greyish yellow, the macrotrichia brown; abdominal tergites dark brown, the hypopygium brighter; male hypopygium with the dorsal lobe of basistyle stout, setiferous to the obliquely truncated apex; outer dististyle attached laterally, the mesal end bifid by a lateral pale spine; inner dististyle bearing a similar lateral spine at near three-fifths its length.

Male.—Length about 4·5 mm.; wing 5·5 mm.

Rostrum and palpi dark brown. Antennæ dark brown throughout, of moderate length (♂), if bent backward extending about to the wing-root. Head with the disk of the vertex extensively dark grey, the posterior orbits and occipital region very restrictedly yellow.

Pronotum reddish grey, the lateral pretergites narrowly light sulphur-yellow. Mesonotal præscutum reddish brown, with a very sparse pruinosity; pseudosutural foveæ pale; scutum dark, the posterior callosities obscure yellow; scutellum obscure yellow; postnotum dark. Pleura reddish brown, very sparsely pruinose, the dorsal pleurites darker. Halteres pale yellow. Legs with the coxæ and trochanters yellowish testaceous; femora dark brown, the bases more obscure yellow; tibiæ light brown, the tips darker; tarsi passing into black; fore tibiæ (♂) with a distinct dilated subbasal ring that is a little darker than the ground-colour. Wings with a greyish-yellow suffusion, brighter yellow at base and in costal region; veins darker than the ground-colour; macrotrichia brown, relatively long and conspicuous, somewhat brighter along the costa. Venation: R_2 lying shortly beyond the level of *r-m*; vein *2nd A* elongate, extending to about opposite one-third the length of the petiole of cell M_1.

Abdomen dark brown, the caudal margins of the sternites very narrowly ringed with yellow; hypopygium brighter, more brownish yellow. Male hypopygium with the dorsal lobe of the basistyle produced caudad into a stout lobe that is setiferous to the apex, the latter obliquely truncated; ventral lobe small, with scattered retrorse spinous setæ; mesal lobe broadly flattened, the apex obtuse. Outer

dististyle of the same peculiar form as in *flavocingulatus*, being attached laterally, the mesal end appearing as a flattened blade that terminates in a blackened spine; before apex on lateral margin bearing a long, gently curved, pale spine; lateral end of style produced into a long, straight, black spine, the outer margin with abundant appressed spinulæ. Inner dististyle longer, appearing as a sinuous flattened rod, at near three-fifths its length bearing a conspicuous black lateral spine; apex of style microscopically spinulose. Ædeagus long and slender.

Hab. Victoria.

Holotype, ♂, Bogong High Plains, altitude 5600–6000 feet, January 1928 (*F. E. Wilson*).

Paratopotype, ♂.

The relationship of *M. extricatus* to *flavocingulatus*, Alexander (New South Wales), is marked, but the two are readily separated by the structure of the hypopygium.

Molophilus grampianus, sp. n.

Belongs to the *gracilis* group and subgroup; most nearly allied to *M. tristylus*; male hypopygium with the ventral lobe of basistyle not ending in a spine; all dististyles and branches shorter and of different conformation, especially the two branches of the outer dististyle.

Male.—Length about 3·2 mm.; wing 4·2 mm.

Rostrum and palpi black. Antennæ (♂) relatively long, if bent backward extending about to the wing-root; antennæ black, the flagellar segments fusiform, with a conspicuous erect white pubescence. Head dark grey, the anterior vertex somewhat more ochreous.

Pronotum dark, the posterior portion more whitish. Lateral pretergites conspicuously pale sulphur-yellow to whitish yellow. Mesonotal præscutum and scutal lobes uniformly dark greyish brown, the tuberculate pits and pseudosutural foveæ dark; median area of scutum and base of scutellum medially light grey, the remainder of scutellum brownish yellow; postnotum brownish black, sparsely pruinose. Pleura dark grey. Halteres dirty white, the knobs very weakly infuscated. Legs with the coxæ brownish yellow, darker basally; trochanters obscure yellow; femora brownish black, the bases restrictedly brighter; tibiæ dark brown, the tips blackened; fore tibiæ (♂) with an enlarged black subbasal ring; tarsi black. Wings yellowish grey, the prearcular and costal regions light yellow; veins pale brown; macrotrichia darker brown. Venation: R_2 lying some distance beyond the level of *r–m*; *m–cu* very oblique, gently

sinuous, about one-half the petiole of cell M_3; vein *2nd A* long and only gently sinuous, ending just beyond the level of the caudal end of *m–cu*.

Abdomen brownish black, pruinose; hypopygium more brownish yellow. Male hypopygium with the lobes of the basistyle poorly developed, low and obtuse, none spinous; ventral lobe small, the stem narrower than the oblique head, the latter with the cephalic angle not produced into a spine, as in *tristylus*, at most with a small setiferous tubercle. Outer dististyle even more profoundly divided than in *tristylus*, appearing as two distinct styles; outer arm shorter and less sinuous than in *tristylus*, the inner arm with the stem shorter, the apical branches widely separated, tong-like. Inner dististyle more slender than in *tristylus*, the apex suddenly narrowed, blackened, and microscopically serrulate; outer margin at near mid-length with a series of microscopic spinulæ. Ædeagus relatively long and slender, subtended by lateral wings or flanges.

Hab. Victoria.

Holotype, ♂, Grampians, October 1928 (*F. E. Wilson*).

Molophilus grampianus is allied to *M. tristylus*, Alexander (New South Wales), but is readily told by the details of structure of the male hypopygium.

Molophilus spiculistylatus, sp. n.

Belongs to the *gracilis* group and subgroup; most closely allied to *M. difficilis*, Alexander (Tasmania), differing especially in the details of structnre of the male hypopygium.

Male.—Length about 4·6 mm.; wing 5·5 mm.

Antennæ black. Lateral pretergites conspicuously light sulphur-yellow. Humeral region of præscutum paler than the disk; scutellum conspicuously dark orange-yellow. Wings with *Rs* and R_{2+3} shorter; R_{4+5} only a little more than one-half *m–cu*; vein *2nd A* shorter, ending opposite the caudal end of vein *m–cu*. Male hypopygium with the glabrous apex of the dorsal lobe of the basistyle longer and somewhat more slender. Outer dististyle with the apical spine arising from a blackened apical cap. Inner dististyle with the extreme apex densely set with microscopic spiculæ to produce a mace-like appearance.

Hab. Victoria.

Holotype, ♂, Bogong High Plains, altitude 5600–6000 feet, January 1928 (*F. E. Wilson*).

It is possible that the present form deserves only subspecific rank under *difficilis*.

Molophilus grandidentatus, sp. n.

Belongs to the *gracilis* group and subgroup; most closely allied to *M. aphanta*, Alexander (Victoria), differing especially in the details of structure of the male hypopygium.

Antennal verticils unusually elongate. The yellow mesonotum contrasts conspicuously with the darkened pleura. Male hypopygium with the inner dististyle shaped about as in *aphanta*, the basal half more blackened and provided on outer margin with two or three powerful black spines; the dilated apex on outer margin with several microscopic appressed spinulæ.

Hab. Victoria.

Holotype, ♂, Belgrave, in dark fern-gully, January 13, 1929 (*F. E. Wilson*).

Paratopotypes, ♂, in poor condition, June 4, 1928 (*F. E. Wilson*); 1 ♂, March 3, 1929 (*T. H. Tregellas*); ♂ ♂, March 31, 1929 (*F. E. Wilson*).

Molophilus truncatus, sp. n.

Belongs to the *gracilis* group and subgroup; most closely allied to *M. tenuiclavus*, Alexander (New South Wales), differing especially in the details of structure of the male hypopygium.

Male.—Length about 3·5–4 mm.; wing 4·3–5 mm.

Female.—Length about 5 mm.; wing 5·8 mm.

Antennæ with the scapal segments only a trifle brighter than the flagellum. Head uniformly yellowish grey. Mesonotal scutellum only vaguely brightened. Ring of fore tibiæ (♂) black, contrasting strongly with the light brown of the remainder of the segment. Wings whitish subhyaline, with a conspicuous brown pattern, including broad seams on the anterior cord, posterior cord, along veins R_5 and *Cu*, and in the axillary region; veins pale, dark brown in the clouded areas. Macrotrichia dark. Venation: R_2 lying opposite or just beyond *r–m*; vein *2nd A* ending opposite *m–cu*. Male hypopygium with the dorsal spine of the basistyle stouter; ventral lobe as in *tenuiclavus*. Outer dististyle as in *tenuiclavus*. Inner dististyle a flattened pale blade, the apex truncated, the outer margin with several conspicuous serrations, the inner margin produced into a conspicuous flange, the margin of which is toothed.

Hab. Victoria.

Holotype, ♂, Melton, May 27, 1928 (*F. E. Wilson*).

Allotype, ♀, Clarkefield, September 27, 1928 (*F. E. Wilson*).

Paratopotype, ♂; *paratypes*, 8 ♂ ♂, with the allotype.

Molophilus phyllis, sp. n.

Belongs to the *pervagatus* group; general coloration brownish black; antennæ (♂) short; legs brownish black, unvariegated; wings with a strong brown tinge, the veins seamed with darker; male hypopygium with the outer basal dististyle a blackened rod, strongly curved at mid-length, thence extended into a long straight point; outer margin at base with a series of tuberculate spines.

Male.—Length about 3·3 mm.; wing 4 mm.

Rostrum and palpi black. Antennæ (♂) short, if bent backward ending far before the wing-root, black throughout; flagellar segments short-cylindrical, with verticils that greatly exceed the segments. Head brownish black.

Thorax entirely brownish black, only the very restricted anterior lateral pretergites before the level of the pseudosutural foveæ narrowly yellowish white. Halteres whitish, the knobs dirty yellow. Legs with the coxæ yellowish brown, the fore coxæ somewhat darker; trochanters obscure yellow; remainder of legs brownish black, unvariegated. Wings with a strong brown tinge, the veins seamed with still darker brown, restricting the ground-colour to pale streaks in the centres of the cells; stigmal region darkened; veins dark brown. Venation: vein *2nd A* relatively short, only gently sinuous, ending before the level of the transverse *m–cu*.

Abdomen black, the hypopygium a trifle paler. Male hypopygium with the basistyle relatively stout, terminating in a small, straight, densely setiferous lobe. Outer dististyle entirely blackened, broadly expanded at base, the apex narrowed into a flattened beak-like portion. Outer basal dististyle a blackened rod, strongly swollen on basal half, curved at a right angle at near mid-length, thence narrowed gradually to an acute straight spine; on outer margin of basal half a series of small but conspicuous tuberculate spines; surface of style densely set with circular squamæ that become more elongate toward apex of style. Inner basal dististyle shorter, appearing as a flattened, somewhat twisted blade, the tip obtuse; before apex on outer margin with a weak appressed spine. Phallosomic structure chitinized, obtusely rounded at apex. Ædeagus elongate.

Hab. Victoria.

Holotype, ♂, Grampians, in tree-fern gully, October 1928 (*F. E. Wilson*).

Molophilus phyllis is amply distinct from all described members of the *pervagatus* group. I take great pleasure

in dedicating the species to Miss Phyllis Estelle Wilson, second daughter of F. Erasmus Wilson.

Molophilus chrysopterus, sp. n.

Belongs to the *pervagatus* group; general coloration light yellowish brown; head yellow, the centre of the vertex restrictedly darkened; halteres light yellow; femora obscure yellow, the tips broadly blackened; fore tibiæ (♂) with a blackened subbasal ring; wings bright yellow, the macrotrichia darker; male hypopygium with the outer dististyle unusually long and slender.

Male.—Length about 4·2–4·4 mm.; wing 5–5·3 mm.

Female.—Length about 5 mm.; wing about 5·5 mm.

Rostrum and palpi black. Antennæ (♂) of moderate length, if bent backward extending about to the wing-root; first scapal segment light yellow, second segment pale brown; flagellum dark brown, the segments oval. Head yellow, the centre of the vertex restrictedly greyish brown.

Pronotum buffy, the anterior lateral pretergites very pale yellow. Mesonotal præscutum almost uniformly light brown, the humeral region and interspaces brighter; scutum brown, the cephalic median and posterior lateral portions of the lobes more yellowish; scutellum obscure yellow; postnotum darker brown. Pleura obscure yellow, the dorsal pleurites with a conspicuous dark brown longitudinal stripe; dorso-pleural region more yellowish. Halteres light yellow. Legs with the coxæ and trochanters yellowish testaceous; fore and middle femora with the basal half obscure yellow, the distal half passing into brownish black; posterior femora obscure yellow, the tips narrowly blackened; tibiæ brownish yellow, the tips narrowly infuscated; fore tibiæ (♂) with a subbasal blackened ring; tarsi brown, passing into black outwardly. Wings with a bright yellow ground-colour, the veins darker yellow; macrotrichia light brown, the costal fringe and a series along the cord darker brown. Venation: R_2 lying some distance beyond the level of *r–m*; petiole of cell M_3 a little less than twice *m–cu*; vein *2nd A* moderately elongate, ending opposite the base of the petiole of cell M_3.

Abdomen dark brown, the posterior margins of the segments obscure yellow; hypopygium obscure reddish brown. Male hypopygium with the apex of the basistyle narrowed into a slender fleshy lobe. Outer dististyle unusually elongate for a member of this group, the base of the head expanded and produced into a blunt tooth, the lower angle further produced into an elongate darkened gently

curved rod. Outer basal dististyle a slender pale rod, gradually narrowed outwardly, terminating in a long acute spine, the surface of the style with conspicuous appressed spines, longer and more evident near the base of the terminal spine. Inner basal dististyle about as long as the outer, but a little broader, appearing as a gently sinuous ribbon-like structure that gradually narrows into an acute spine. Ædeagus elongate, relatively wide.

Hab. Victoria.

Holotype, ♂, Bogong High Plains, altitude 5600–6000 feet, January 1928 (*F. E. Wilson*).

Allotopotype, ♀.

Paratopotypes, 8 ♂ ♀.

Molophilus decinctus, sp. n.

Belongs to the *pervagatus* group; closely allied to *M. chrysopterus*, sp. n., differing especially in the lack of a blackened subbasal ring on the fore tibia of the male and in the details of structure of the male hypopygium.

Male.—Length about 3·2–3·5 mm.; wing 4–4·4 mm.

Rostrum and palpi brownish black. Antennæ (♂) relatively elongate, if bent backward extending to shortly beyond the wing-root; scapal segments yellow; flagellum dark brown, the incisures restrictedly pale. Head yellowish brown.

Mesonotal præscutum pale reddish brown, the humeral and broad lateral regions paling into yellow; remainder of mesonotum pale yellow, the postnotum darkened posteriorly. Pleura pale testaceous-yellow. Halteres relatively long, pale yellow. Legs with the fore coxæ brownish testaceous, the remaining coxæ yellow; trochanters yellow; femora obscure yellow, clothed with brown setæ, the tips scarcely darkened; tibiæ pale brown, the fore tibiæ with a scarcely evident subbasal ring that is not blackened; tarsi brownish black. Wings with a pale yellow suffusion, the veins darker yellow; macrotrichia brown. Venation: R_2 lying shortly beyond the level of *r–m*; vein *2nd A* ending about opposite the cephalic end of *m–cu*.

Abdomen pale yellowish brown, the hypopygium obscure yellow. Male hypopygium with the outer dististyle having the head stout, simple, the apex depressed to the thickened margin, forming a flattened beak-like portion. Outer basal dististyle slender, strongly curved, narrowed outwardly, terminating in a long straight spine; just before the base of

this spine with a few appressed spinulæ; in the paratype with a few more basal spiculæ. Inner basal dististyle stouter than in *chrysopterus*, appearing as a flattened sinuous ribbon-like structure that gradually narrows to an acute terminal spine.

Hab. Victoria.

Holotype, ♂, Bogong High Plains, altitude 5600–6000 feet, January 1928 (*F. E. Wilson*).

Paratopotype, ♂, Tarn B.

XL.—*Contributions to a Study of the British Species of* Machilidæ.—III. *The Genus* Patrobius, *Leach.* By H. Womersley, A.L.S., F.E.S.

The generic name *Petrobius* was first established by Leach in 1809 for *P. maritimus*.

In 1904 Prof. Silvestri defined the genus more fully, and separated it from the rest of the Machilidæ as follows:—

"Abdominal segments 2-5 or 2-6 with two pairs of abdominal segments	Genera *Petrobius* and [*Machilis*.
Male with paired genital appendages on the ninth abdominal segment only, shorter than the penis. Penis long	Gen. *Petrobius*, type [*P. maritimus*, Leach."

In 1911, in a study of the North American Machilidæ, he described several species of *Petrobius* and placed them in a new subgenus, *Pedetontas*, which he defined thus:—

"Eighth subcoxæ in male produced into prominent rounded lobes. Genital appendages not annulated. Penis long, reaching beyond tip of ninth segment	Subgen. *Petrobius*, [s. str.
Eighth subcoxæ in male not produced. Genital appendages annulated. Penis very short, not reaching tip of ninth segment........	Subgen. *Pedetontas*, nov., type *P. californicus*, sp. n."

In 1913 Dr. G. H. Carpenter published a detailed description of a common Irish and British species, which he regarded as *P. maritimus*, Leach. In the same year he diagnosed a new Irish species, *P. brevistylis*, which differed from *maritimus* chiefly in that the subcoxæ of the eighth abdominal segment in the male were produced into rounded lobes. In this character, Dr. Carpenter indicated that the species he took for *P. maritimus* of Leach was not the one given by Silvestri as the type of his subgenus *Petrobius*,

s. str. He (Dr. Carpenter) suggested that Silvestri had been comparing the species described by Oudemans in 1887 as *Machilis maritima*, Latr., from Holland. For this Dutch species he proposed the new name *oudemansi*.

In the same paper, Dr. Carpenter alluded to Verhoeff's classification of the Machilidæ, published in 1911, in which a species from the Adriatic was given as the type of a new genus under the name of *Halomachilis adriatica*, Verhf. It was shown that Verhoeff's genus was undoubtedly the same as *Petrobius*, Leach. Verhoeff, however, gave a very good character by which the genus under discussion can be distinguished from the rest of the Machilidæ, viz., that the antennæ are only scaled on the two basal joints.

In 1905, Miss A. J. Reilly described another British species from the Isle ot Wight as *P. vectensis*, while in 1923 Dr. Jan Stach published a description of *P. balticus* from the Polish coast. In the latter year, Mr. R. S. Bagnall diagnosed two more species from the Yorkshire coast as *P. carpenteri* and *P. modestus*.

Finally, in 1927, I described a species from the south-west of England as *P. silvestri*, and at the same time indicated that *P. modestus*, Bagnall, was but an immature form of some other species, probably his *carpenteri*.

The following, then, are the species of Petrobii that have been described from Britain and Europe :—

Petrobius maritimus (Leach), Carp.
—— (*H.*) *adriatica*, Verhff.
—— *brevistylis*, Carp.
—— *oudemansi*, Carp. (*martimus* (Leach), Silv.).
—— *vectensis*, Reilly.
—— *balticus*, Stach.
—— *carpenteri*, Bagnall = *modestus*, Bagnall.
—— *silvestri*, Womersley.

The genus *Petrobius*, as a result of the writings of Prof. Silvestri, Dr. Carpenter, and Dr. Verhoeff, can be defined as follows :—Antennæ scaled on the two basal joints only. Coxal processes on the second and third pairs of legs. Two pairs of exertile vesicles on abdominal segments 2–5, one pair on 1, 6, and 7. Paired genital appendages only on segment ix., annulated (subgenus *Pedetontas*, Silv.) or not (subgenus *Petrobius*, s. str.). Eighth subcoxæ produced or not in the male.

In defining his subgenus *Pedetontas*, Silvestri stresses the prolongation of the eighth subcoxæ and the annulation of

the genital appendages (gonapophyses) in the male. In the present known European forms, the gonapophyses are always unannulated, while the eighth male subcoxæ may or may not be prolonged. The annulation or otherwise of the gonapophyses would seem, therefore, to be the best generic feature for the separation of these two subgenera. The subgenus *Petrobius*, therefore, would possess species both with and without eighth subcoxal lobes, and the apparent disagreement between *Petrobius*, Leach, as understood by Dr. Carpenter and Prof. Silvestri, disappears.

All European species, so far known, belong to the subgenus *Petrobius*, and can be placed in two sections, according as to whether the eighth subcoxæ of the male are prolonged into rounded lobes.

Section I.—Subcoxæ of eighth abdominal segment in male prolonged into rounded lobes.

Petrobius brevistylis, Carp.

This species was described by Dr. Carpenter from specimens taken at Portrane, Co. Dublin, Ireland, in 1913.

In the hope of obtaining more specimens, my friends Mr. A. W. Stelfox and Mr. E. O'Mahoney, of the Dublin Museum, not only searched the original locality, but also many other parts of the Irish coast. Although everywhere Petrobii were found in large numbers, no specimens could be obtained which could be referred to *brevistylis*.

Curiously, however, the specimens found belonged to two species, one the form described as *maritimus* (Leach), Carp., and the other to *carpenteri*, Bagnall. This latter species, according to the descriptions, differs from *brevistylis* mainly in that the stylets of the ninth abdominal segments are longer and exceed the penis in length, while the apical spines are also proportionately longer. Other slight differences exist in the relative lengths of the last two joints of the maxillary palpi. During the last few years, however, my examination of some hundreds of specimens convinces me that little reliance can be placed on this last character for specific determinations. In one otherwise typical specimen of *carpenteri*, one palp was normal and the other had the apical joint only half the length of the last but one.

These negative results in the search for more material of *brevistylis* led me to make a re-examination of what was still available of Dr. Carpenter's original material. Through the kindness of Mr. Stelfox, I was able to obtain the loan of

some half-dozen slides of dissections and a tube containing seven specimens in spirit from the original locality.

From my critical examination of this material, I am forced to the opinion that the specimens, especially the males (alone represented on the slides), from which Dr. Carpenter evidently drew his description, were malformed. The ninth abdominal stylets are decidedly abnormally shortened, with the apical spine practically absent. In all other details, including the maxillary palpi, labial palpi, eighth subcoxæ, stylets on the other abdominal segments, dimensions of penis, cerci, etc., they agree entirely with the same sex of *carpenteri* that I have from the Irish, British, and French coasts. In the females, there was likewise complete agreement, except in the ninth stylets. In this sex, the ninth stylets were but little shorter, although the apical spines were mostly broken, and in some cases the broken end had been rounded off by wear.

There seems to be no doubt, therefore, that *brevistylis* and *carpenteri* are normally identical, and, though the first name is a misnomer, it has priority.

Through the kindness of Mr. S. L. Tuxen, of the Copenhagen Museum, I have also been able to examine specimens of *Petrobius balticus*, Stach, from the Danish coast. Here, again, careful comparison shows that there is no essential difference between this species and *carpenteri*, Bagnall.

With regard to the Dutch species, which Oudemans described in 1887, and to which Dr. Carpenter gave the name *oudemansi* in place of *maritimus*, as used by the original author, the only apparent differences between it and *carpenteri* are: (1) the rather short penis, which is only half the length of the ninth stylet; (2) the last joint of the maxillary palpi is only half the length of the last but one; and (3) the lacinia of the maxillary palpi is longer than the galea. The first of these characters is not definite enough, and probably due to immaturity. The second I have shown to be unreliable in these insects for specific differentiation. The third may be of value, but as no recent material referable to Oudeman's description has been found, I am doubtful. Moreover, in his description of *maritimus*, Leach, Dr. Carpenter gives the lacinia as longer than the galea, but an examination of his slides, from which this description was evidently drawn up, shows that a slight folding at the base of the galea has taken place, and that, when allowance for this is made, the galea exceeds the lacinia in length. This is also borne out by other specimens in which folding of the galea has not occurred. *P. oudemansi*, Carp. (*maritimus*,

Oudemans, Silv.), must, therefore, for the present be considered as synonymous with *brevistylis*, Carp.=*carpenteri*, Bagnall.

The synonymy of this species, then, is as follows:—

Syn. ? *oudemansi*, Carp. 1913=*maritimus*, Oude., Silv., 1904.
carpenteri, Bagnall, 1923.
modestus, Bagnall, 1923.
balticus, Stach, 1923.

This is a common species, and occurs all around the British and Irish coasts, and also on the French, Dutch (?), and Baltic coasts.

Petrobius vectensis, Reilly.

This species was described by Miss A. J. Reilly in 1915 (Ann. & Mag. Nat. Hist. ser. 8, vol. xvi. no. 91), from specimens taken at St. Helens and Shanklin, in the Isle of Wight.

According to the description, it differs from the more recently described *P. carpenteri*, Bagnall, in the relative lengths of the last two joints of the maxillary palpi, and in the female in having the subcoxæ of the eighth sternite produced into pointed processes.

Unfortunately, endeavours to trace the original slides of dissections, from which the drawings and descriptions were made, have failed, and all that now remains are two tubes containing parts of three specimens. From these little information is to be derived, for the essential parts, viz., the eighth and ninth sternites, are missing.

The proportions of the last two joints of the maxillary palpi which are present do not, however, agree with those given in the description, *i.e.*, 11 : 10, but are, as in *carpenteri*, 5 : 4. Earlier in this paper, I have shown that these proportions must not be used too much for specific determinations.

The pointed processes of the eighth subcoxæ of the female may be a good character, but, nevertheless, although I have examined some hundreds of specimens of Petrobii from the original locality, kindly collected for me by Prof. Poulton and friends, I have failed to detect any females agreeing with the description. In corresponding with Dr. Carpenter on this point, he replies that:—"After reading what you tell me I cannot doubt a suggestion made to me by Mr. L. S. Tuxen (of Copenhagen) that the female abdominal segment from which Miss Reilly made her drawing must have been distorted by folding of the subcoxæ."

There seems, then, to be considerable doubt about this species, but, in view of the unsatisfactory nature of what little remains of the original material, I refrain from sinking it. If time proves it to be non-existent as a distinct species, it must be regarded as conspecific with *carpenteri*, Bagnall, and therefore with *brevistylis*, Carp.

Section II.—Subcoxæ of the eighth abdominal segment in the male not produced.

Petrobius maritimus (Leach), Carp., nec Silv.

Syn. *silvestri*, Womersley, 1927.

This species was diagnosed by Dr. Carpenter in 1913, when he indicated that it was not the same as Silvestri's type of the subgenus *Petrobius*, s. str.

I have examined Dr. Carpenter's slides, as well as many of his spirit-specimens from the Irish and British coasts, and compared them with my own specimens and description of *P. silvestri*, mihi, from Devonshire. As I have already pointed out, the lacinia does not exceed the galea in length, and in this resembles *silvestri*. It is also stated that the mandibles are but faintly toothed when new. In my experience, they are very distinct at first, but soon wear away. After examination, therefore, of a very large amount of material, I have no doubt but that these two species are synonymous.

P. maritimus occurs plentifully around the Irish and British coasts, and I have had numerous examples from the north of France, Lundy, and the Scilly Isles.

Petrobius (*Halomachilis*) *adriatica*, Verhoeff.

Beyond quoting this as the type of his genus *Halomachilis*, Verhoeff does not appear to have ever given a detailed description, and I am, therefore, unable to compare it with the other species, or to say in which section it should be placed.

Summary.

Only three species of *Petrobius* occur in Great Britain, one of which has been found only in the Isle of Wight, and, further, has not been found since it was originally described. It is, therefore, a little doubtful at present. The other two species are very plentiful on all suitable parts of the coast.

Our two common species also occur in France, Holland, Denmark, and Poland.

A fourth species has been recorded from the Adriatic, but whether it is the same as those from Britain and Northern Europe is at present indeterminate.

References.

Leach, W. E. 1809. "Entomology," in Brewster's 'Edinburgh Encyclopædia,' ix.

Oudemans, J. T. 1887. "Beitrage zur Kenntnis der Thysanuren und Collembolen." Bijdr. tot de Dierkunde (Amsterdam).

Silvestri, F. 1904. "Nuovi Generi e Specie di Machilidæ." Redia, ii.

——. 1911. "Contributo alla conosienza dei Machilidæ dell' America settentrionale." Boll. Lab. Zool. Portici.

Verhoeff, K. W. 1911. "Ueber Felsenspringer, Machiloidea, 4 Aufsatz; Systematik und Orthomorphose." Zool. Anz. xxxvi.

Carpenter, G. H. 1913. "Apterygota," Clare Island Survey. Proc. Roy. Irish Acad. xxi. pt. 32.

——. 1913. "The Irish Species of *Petrobius*," Irish Nat. xxii.

Reilly, Miss A. J. 1915. "Notes on the British Machilidæ, with Descriptions of Two new Species." Ann. & Mag. Nat. Hist. ser. 8, vol. xvi. pp. 10–15.

Bagnall, R. S. 1923. "On some British Machilidæ." J. Econ. Biol. vol. x. no. 4.

Stach, J. 1923. "*Petrobius balticus*: eine neue Art aus Pommern etc." Odbitke z Rozz i Wiad. z Muzeum in Dzied, tom. vii.–viii., Rok. 1921–22.

XLI.—*Oxford University Greenland Expedition*, 1928.—*Coleoptera from Greenland*. By K. G. Blair, B.Sc., F.E.S.

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The Coleoptera collected by Major R. W. G. Hingston in the Godthaab Fj. (at Kugssuk, 30 feet, and Matuola, 2000 feet) include 180 specimens, representing 11 species, most of them in long or fairly long series, as follows:—

Carabidæ.

1. *Patrobus septentrionis*, Dej.—7 ex., Kugssuk, 4 in bog moss, 3 under stones: 28.vi.–2.viii.

2. *Bradycellus* (*Trichocellus*) *cognatus*, Gyll.—5 ex., Matuola, under stones: 6.vii.

3. *Bembidion grapei*, Gyll.—13 ex., Kugssuk, 3 on animal hummocks, 4 under stones: 26.vi.–9.vii.; Matuola, [illegible] under stones: 6–7.vii.

Dytiscidæ.

4. *Hydroporus melanocephalus*, Marsh.—39 ex., Kugssuk, 26.vi., 7 and 24.vii., 1.viii., very common in bog pools.

Hydroporus sp., Schiödte (*H. nigrita*, Zett., nec F.).
Hydroporus atriceps, Crotch (Henriksen and Lundbeck).
Hydroporus melanocephalus, Gyll. (Europ. Catal.).
Hydroporus morio, Sharp (Leng's List).

The synonymy of this species appears to be somewhat confused, but the above is adopted from Zimmermann in Junk's Coleopt. Catal. pars 71, 1920.

The confusion seems to have arisen from the assumption that the *H. melanocephalus* of Stephens was in reality identical with *H. melanocephalus*, Marsham, but a comparison of the descriptions given by these authors makes it evident that they were dealing with different insects. *H. melanocephalus*, Steph. (nec Marsh.), is represented in his collection at the British Museum by seven specimens, of which six are *H. pubescens*, Gyll., and one is *H. erythrocephalus*, L. The description of *melanocephalus*, Marsh., does not fit either species, whereas with *H. atriceps*, Crotch (*H. morio*, Sharp), it agrees well.

5. *Colymbetes dolabratus*, Payk., var. *grœnlandicus*, Aubé.—24 ex., Kugssuk, 23 in rock-pools: 26.vi.–27.vii.; Matuola, 1 in rock-pool: 7.vii.

Dytiscus marginalis, O. Fab.

Gyrinidæ.

6. *Gyrinus opacus*, Sahlb.—23 ex., Kugssuk: 26.vi., 22.vii., in bog pools.

Gyrinus sp., Schiödte.
Gyrinus marinus, Gyll. (Henriksen and Lundbeck).

Though now considered distinct species (Ahlwarth, in Junk's Coleopt. Catal. pars 21, 1910), *G. opacus*, Sahlb., and *G. marinus*, Gyll., were long held to be but forms of one. There is no evidence that more than one species occurs in Greenland. For the determination I am indebted to Mr. J. Omer Cooper, who considers the Greenland form to be a melanic northern variety, perhaps a little smaller and with darker legs than British examples, but not worthy of subspecific rank. The dark coloration of the legs of Greenland examples has already been referred to by Leconte (Proc. Ac. Nat. Sci. Philad. 1868, pp. 369, 372)*.

* Since the above was written, the Greenland form has been named by Mr. Omer Cooper as *G. opacus*, var. *lecontei*, Coop. (Ent. Mo. Mag. lxvii. 1930, p. 68).

Coccinellidæ.

7. *Coccinella transversoguttata*, Fald.—43 ex., Kugssuk: 27.vi.–24.vii., many on birch and willow.

Coccinella trifasciata, O. Fab.

Byrrhidæ.

8. *Byrrhus fasciatus*, Först.—2 ex., Kugssuk: 9 and 11.vii., under stones.

Cistela stoica, Müll. (O. Fab.).
Byrrhus kirbyi, Lec. (Leng's List).
Byrrhus picipes, Kby. (Leng's List).

Leng retains *B. kirbyi*, Lec. (*B. picipes*, Kby.), as distinct from *B. fasciatus*, Först., but on an examination of the type of *B. picipes* I am unable to recognize any difference.

Curculionidæ.

9. *Otiorrhynchus arcticus*, O. Fab.—15 ex., Matuola, 6.vii.

Otiorrhynchus monticola, Germ. (Leng's List).

Leng cites *O. arcticus*, O. Fab., with a (?) as a synonym of *O. monticola*, Germ., whereas if really identical their respective positions should be reversed. Germar's species was described from the Pyrenees.

10. *Otiorrhynchus nodosus*, O. Fab.—10 ex., all under stones: 8, Kugssuk, 27.vi.–11.vii.; 2, Matuola, 6–7.vii.

Otiorrhynchus dubius, Ström. (Henriksen and Lundbeck, and the European Catalogue).

The species was fully described by O. Fabricius, and the specific name is usually attributed to him, though by him it was ascribed to Müller (1776).

11. *Phytonomus elongatus*, Payk.—1 ex., Matuola, 6.vii., under stone.

The Coleopterous Fauna of Greenland.

The earliest record of the beetle fauna of Greenland is contained in 'Fauna Groenlandica,' by Otto Fabricius (1780). It is a little remarkable that of the twelve species there described the identity of six remains still in doubt, species never having been found by subsequent collectors.

Some of these no doubt were casual introductions, but it is unfortunate that the opportunity was not taken to make special efforts to confirm some at least of these old records. It may be of interest to note them in detail :—

Altica helxines, L., taken on the mud walls of the huts.

Altica oleracea, L., occurred in some numbers on cabbages in the author's garden at Friderichshaab.

Tenebrio fossor, L. Considered by Schiödte and subsequent authors as probably synonymous with *Patrobus septentrionis*, Dej., but details of the description given by Fabricus, notably "tibiis anticis palmato-digitatis" and "antennæ .... moniliformes," are at variance with such determination. It seems more probable that Fabricius was correct in his determination of *Clivina fossor*, L., of modern authors, though this insect has not been since found in Greenland. The author adds the interesting note that it is said by the natives to penetrate the human ear, whence it may be ejected by the application of seal-oil. This suggests some possible confusion on the part of his informant with *Forficula auricularia*, an insect not recorded by him, though now known to occur in the country.

Staphylinus balteatus, Müll., synonymised by the author with *Creophilus* (*Staphylinus*) *maxillosus*, L.

Said to occur not commonly under stones. Though not since recorded from Greenland, it is found in Iceland and Arctic America, so that its occurrence in Greenland is by no means improbable.

Staphylinus fuscipes, L., and *S. lignorum*, L.

Two small insects, the former "Pediculo paulo major," the other "similis sed minor," that have not since been definitely identified. Both were found in houses, the former once only, the latter frequently in rotten wood in the rafters.

In 1857 Schiödte gave a list of 18 species including five of those recorded by O. Fabricius. Three of these, *Nebria nivalis*, *Anthobium sorbi*, and *Rhytidosomus orobinus*, sp. n., are noted as having been collected by Holböll, and it is of interest to note that the British Museum possesses a small

series of Insects from Greenland presented in 1841 by M. Boie of Kiel, and collected by "Capt. Hollboell, R.N." As none of the three species above mentioned is represented in the Museum series, it would seem that the latter was a set of duplicates presented to the Museum by M. Boie. The Coleoptera of this set, according to the Museum Register, were as follows, the modern names being added in brackets :—

Otiorrhynchus maurus, Gyll. (*O. nodosus*, O. Fab.).
Otiorrhynchus lævigatus, Gyll. (*O. arcticus*, O. Fab.).
Colymbetes dolobratus, Gyll.
Hydroporus nigritus, Gyll. (*H. melanocephalus*, Marsh.).
Gyrinus marinus, Gyll. (*G. opacus*, Sahlb.).
Coccinella ephippiata, West. (*C. transversoguttatus*, Fald.).
Helobia gyllenhali, Schönh., aff. ? (*Patrobus septentrionis*, Dej.).
Byrrhus pillula (*B. fasciatus*, Forst.).

More recently (1918), a more extensive list of the Land Arthropods of Greenland is given by K. L. Henriksen and W. Lundbeck *. In this list 41 species of Coleoptera are enumerated, in addition to five of doubtful identity recorded by O. Fabricius and certain others of which the authors have no definite records, viz. :—

Carabus chamissonis, Fish. (*Carabus grœnlandicus*, Dej.).
Pterostichus (*Cryobius*) *arcticus*, Chaud.
Agabus (*Gaurodytes*) *congener*, Thunb.

It may be noted further that in Leng's 'Catalogue of the Coleoptera of America North of Mexico,' *Curtonotus borealis*, Chaud. (doubtfully), and *Acrotona parva*, Sahlb., are recorded from Greenland.

From the zoo-geographical standpoint it is noteworthy that the beetle fauna of Greenland is essentially of European rather than of American origin. The great majority of the species are of holarctic distribution, but, disregarding those that have obviously been introduced by commerce, about one-third of the whole are not known to occur in arctic N. America; on the other hand, but one or perhaps two species of N. American origin, viz., *Carabus chamissonis*, Fish., and *Curtonotus borealis*, Chaud., have been recorded, both somewhat doubtfully, from Greenland. One species, *Micralymma brevilingue*, Schiödte, has apparently not yet been detected outside Greenland.

The following table shows the distribution outside Greenland of the constituent species of its fauna :—

* For *Nephus redtenbacheri*, Muls., of Henriksen and Lundbeck's list [illegible] substitute *N. limonii*, Donisth. (*vide* Lindroth, 1929).

Distribution of the Coleoptera of Greenland.

	N. Eur.	Iceland.	Siberia.	N. Amer.
? Carabus chamissonis, *Fish.*, v. grœnlandicus, *Dej.*	..	..	..	×
Nebria gyllenhali, *Schönh.*	×	×	×	×
? Clivina fossor, *L.*	×	..	×	×
Bembidion grapei, Gyll.	×	..	×	×
Patrobus septentrionis, Dej.	×	×	×	×
Bradycellus cognatus, Gyll.	×	×	×	×
? Pterostichus arcticola, *Chd.*	×	..	..	×
? Curtonotus borealis, *Chd.*	..	..	?	×
Hydroporus melanocephalus, Marsh. (*atriceps*, Crotch.)	×	×	×	×
? Agabus congener, *Thunb.*	×	..	×	×
Colymbetes dolabratus, v. *grœnlandicus*, Aubé	×	×	..	×
Gyrinus opacus, Sahlb.	×	×	×	×
Atheta islandica, *Kr.*	×	×	×	
—— fungi, *Gr.*	×	..	×	×
? —— parva, *Sahlb.*	×			
Gnypeta cavicollis, *Sahlb.*	..	..	×	
Quedius mesomelinus, *Marsh.*	×	×	×	×
—— boops, *Gr.*	×	×	×	
? Creophilus maxillosus, *L.*	×	×	×	×
*Lathrobium fulvipenne, *Gr.*	×	×	×	?
Micralymma brevilingue, *Schiödte*				
—— marinum, *Stroem.*	×	×		
Omalium excavatum, *Steph.*	×	×	×	
Xylodromus concinnus, *Marsh.*	×	×		
Anthobium sorbi, *Gyll.*	×	..	×	×
*Enicmus minutus, *L.*	×	×	×	×
*Lathridius bergrothi, *Reitt.*	×			
*Cryptophagus validus, *Kr.*	×			
*—— acutangulus, *Gyll.*	×	..	×	×
*Dermestes lardarius, *L.*	×	×	×	×
*Attagenus pellio, *L.*	×	..	×	×
*Athrenus sp. (? muscorum)	×	..	..	?
Byrrhus fasciatus, Forst.	×	×	×	×
Simplocaria metallica, *Sturm.*	×	..	×	×
*Ptinus fur, *L.*	×	×	×	×
*Liozoum molle, *L.*	×	×	×	×
Melanophila acuminata, *De G.*	×	..	×	×
Otiorrhynchus nodosus, O. Fab.	×	×	×	×
—— *arcticus*, O. Fab.	×	×	×	×
Phytonomus elongatus, Payk.	×	..	×	
Rhytidosomus globulus, *Hbst.*	×	..	×	
*Pityogenes chalcographus, *L.*	×	×	×	
*Tetropium castaneum, *L.*	×	..	×	
*Callidium violaceum, *L.*	×	×	×	×
*—— variabile, *L.*	×	..	×	×
*Pogonochærus fasciculatus, *De G.*	×			
Coccinella transversoguttata, Fald.	×	..	×	×
Nephus limonii, *Donisth.*	×			

A * indicates introduced species, a ? species of which records for Greenland require confirmation; names in italics are of species collected by Major Hingston.

The four names following have been omitted from the table owing to uncertainty regarding the species intended. They are all mentioned by O. Fabricius :—

Altica helxines, L.
,, *oleracea*, L.
Staphylinus fuscipes, L.
,, *lignorum*, L.

Literature cited.

(1) 1776. Müller, O. F. 'Zoologiae Danicae Prodromus, seu Animalium Daniae et Norvegiae indigenarum, etc.
(2) 1780. Fabricius, Otto. 'Fauna Groenlandica.'
(3) 1857. Schiödte, J. C. In Rink, "Grönland geographisk og statistisk beskrevet, Bd. ii.—Part 3. Landarthropoder etc."
(3 *a*) 1859. ——. A German translation of the above in 'Berliner Entomologische Zeitschrift,' pp. 134–157.
(4) 1906. Heyden (L. v.), Reitter (E.), Weise (J.). 'Catalogus Coleopterorum Europæ.'
(5) 1918 (1917). Henriksen (Kai L.) og Lundbeck (Will.). 'Meddelelser om Grönland, Landarthropoder.'
(6) 1920. Leng, C. W. 'Catalogue of the Coleoptera of America North of Mexico.'
(7) 1929. Lindroth, C. H. "Zur Landevertebratenfauna Islands" (11), p. 22. (Göteborgs Kungl. Vetenskaps. Handlingar, femte följden, Ser. B, Band 1, no. 6.)

XLII.—*Notes on new or less-known Holarctic* Decticinæ (*Orthoptera*, Tettigoniidæ). By B. P. Uvarov.

Decticus verrucivorus gracilis, subsp. n.

Differs from the typical (North European) race by the slender habitus, relatively very long elytra, and the absence of green colour.

Total length, ♂ 30, ♀ 32 ; pronotum, ♂ 9, ♀ 9·5 ; total length of elytron ♂ 37, ♀ 45 ; distance from the base of the radial branch to the apex of the elytron, ♂ 26, ♀ 30 ; width of the elytron at the middle of the radial branch ♂ 7, ♀ 8 ; length of hind femur, ♂ 30, ♀ 36 ; ovipositor, ♀, 24 mm.

Northern Caucasus : Terekli-Mekteb, 6. vi. 1926, 3 ♂ ♂, 1 ♀ ; Kamysh-Burun, 10. vi. 1926, 2 ♀ ♀ (including the type) (*V. Bassii*).

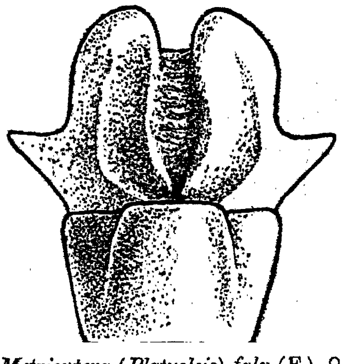
Type in the Zoological Museum of the Russian Academy of Sciences ; paratypes in the British Museum.

Metrioptera (*Platycleis*) *falx* (Fabricius). (Fig. 1.)

1775. *Locusta falx*, Fabricius, Systema Entom. p. 286. no. 21.
1781. *Locusta falx*, Fabricius, Species Insect. p. 359. no. 21.
1787. *Locusta falx*, Fabricius, Mantissa Insect. i. p. 233.
1793. *Locusta falx*, Fabricius, Entom. System. ii. p. 41. no. 30.
1815. *Conocephalus falx*, Thunberg, Mem. Acad. Imp. Sci. St. Petersb. v. p. 273.

It is a very surprising fact that the insect from Madeira, described under the name *Locusta falx* in all books by Fabricius, has been overlooked by all later authors, except Thunberg. The name does not appear even in the supposedly complete catalogues, like that of Kirby, and this means that the habit of relying on another man's work, instead of looking up the original sources, is a very old one. A happy exception is offered by Sherborn's 'Index Animalium,' in which references to both Fabricius's and Thunberg's descriptions are given.

Fig. 1.



Metrioptera (*Platycleis*) *falx* (F.), ♀.

The type of *Locusta falx* is in the Banks collection in the British Museum, and its study convinced me that this is a good species related to *Metrioptera* (*Platycleis*) *laticauda*, Br. W. Its re-description is offered, as follows:—

♀.—Very similar in the general appearance to *M.* (*Pl.*) *intermedia*, Serville. The seventh sternite with a large truncate tubercle similar to that in *M.* (*Pl.*) *affinis*, Fieber. Subgenital plate as in *M.* (*Pl.*) *laticauda*, Br. W., while the ovipositor is still broader than in the last-named species.

♂.—Last tergite with an oval impression; hind margin sinuate-truncate, with a small excision in the middle. Cerci with a short tooth behind the middle.

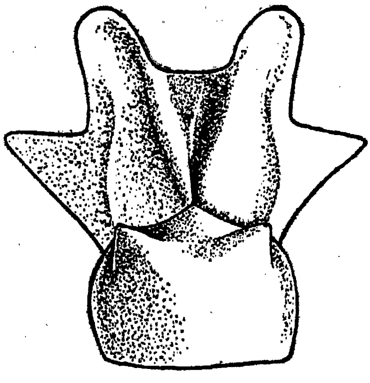
Total length, ♂ 23, ♀ 24; pronotum, ♂ 6·5, ♀ 7·5; elytra, ♂ 25, ♀ 30; hind femur, ♂ 22, ♀ 24; ovipositor, ♀, 10 mm.

The species has been described from Madeira, and there are now in the Banksian collection two original specimens; one of them, bearing a label "Madeira," is selected here as the type. There are in the general collection of Orthoptera at the British Museum 2 ♂♂ and 3 ♀♀ of this species, also from Madeira, collected by Wollaston; one of them has been named by Fischer as *Decticus griseus*, var. *intermedius*.

Metrioptera (*Platycleis*) *kashmira*, sp. n. (Fig. 2.)

Of the size of *M. albopunctata*, Goeze, but of more robust build, and with the elytra not quite reaching to the apex of the abdomen.

Fig. 2.



Metrioptera (*Platycleis*) *kashmira*, sp. n., ♀.

♀ (*type*).—Sixth sternite broadly and not strongly convex. Seventh sternite with two sublateral, obtusely conical tubercles behind the middle; hind margin with a small projection. Subgenital plate with a broad median sulcus, which is broader and open behind; the lobes divergent, short, broadly rounded. Ovipositor a little longer than pronotum, broad basally, gradually narrowed, and moderately recurved towards the apex.

Elytra reaching the apex of the last tergite, strongly narrowed towards the parabolic apex; their pattern as in other species of the subgenus *Platycleis*.

Hind femora relatively short and robust, coarsely punctured and transversely rugose, with the typical pattern well marked in brown.

♂ (*paratype*).—Last tergite with an oval depression; hind margin with a parabolic excision and triangular, slightly decurved lobes. Cerci with a hook behind the middle.

Total length, ♂ 20, ♀ 21; pronotum, ♂ 5·5, ♀ 6·5; length of elytron (L.), ♂ 14, ♀ 14·5; distance from the base of the radial branch to the apex of elytron (l.), ♂ 5, ♀ 6; width of the elytron at the middle of the radial branch (b.), ♂ 2, ♀ 2·5; length of hind femur, ♂ 17, ♀ 19·5; ovipositor, ♀, 9 mm.

Kashmir, Srinagar, Perimahal, 5000 feet, 10 Oct., 1923, 2 ♂♂, 3 ♀♀; do., July 1923, 1 ♂, 2 ♀♀ (Fletcher coll.).

Type in the British Museum.

This interesting species resembles *M. fatima*, Uv., in the structure of the female abdomen, but differs from all species of the genus by the length and the shape of the elytra, which are of the same type as in other members of the subgenus *Platycleis*, but abbreviated. The proportions of the elytra calculated, as suggested by Zeuner (Mitt. Zool. Mus. Berlin, xv. 1929, p. 201, ff.), are l.: L., ♂ 0·36, ♀ 0·41; l.: b., ♂ 2·5, ♀ 2·4. These figures diverge strongly from those for other species of *Platycleis* investigated in this respect by Zeuner, and they support his idea that the reduction of the length of elytra in this group occurs mainly at the expense of the apical part.

Metrioptera (*Metrioptera*) *sphagnorum* (Walker). (Fig. 3.)

1869. *Decticus sphagnorum*, Walker, Cat. Derm. Salt. Brit. Mus. ii. p. 258.
1894. *Decticus sphagnorum*, Scudder, Canad. Ent. xxvi. p. 183.
1906. *Orchelimum sphagnorum*, Kirby, Syn. Cat. Orth. ii. p. 274.
1907. *Platycleis fletcheri*, Caudell, U.S. Nation. Mus. xxxii. p. 408, fig. 87 (*syn. nov.*).

An examination of the types of this species in the British Museum demonstrated that it is, contrary to Scudder's opinion (*l. c.*), a true Decticid and a member of the genus *Metrioptera*; a comparison of the types with Caudell's description of *Platycleis fletcheri* leaves no doubt as to the identity of the two species. Since the female sex has been described by Caudell, it will be sufficient to describe here the male abdominal characters as follows:—

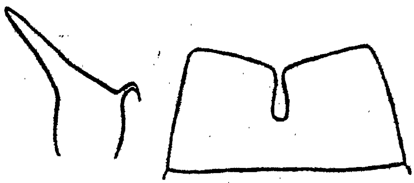
♂.—Last tergite very large, trapezoidal, with straight margins, cleft behind to the middle. Cerci concealed under

the last tergite, short, conical, stout, with a pointed, strongly curved hook near the base. Subgenital plate with a rectangular emargination.

Total length, ♂ 17, ♀ 17·5; pronotum, ♂ 5·5, ♀ 5; elytra, ♂ 7, ♀ (macropterous form) 24; hind femur, ♂ 12·5, ♀ 13; ovipositor, ♀, 12 mm.

The original series consists of four brachypterous males (one of them selected by me as the single type) and one macropterous female, all from St. Martin's Falls, Hudson's Bay.

Fig. 3.



Metrioptera (*Metrioptera*) *sphagnorum* (Wlk.); ♂, last tergite and right cercus.

M. sphagnorum exhibits a strong relationship to the Old World species of the same genus (*bicolor*, *rœselii*, *brachyptera*), though differing from them considerably in the structure of genitalia. The elytral proportions of the macropterous female, calculated by Zeuner's method (Mitt. Zool. Mus. Berlin, xv. 1929), are l. : L. = 0·66 and l. : b. = 2·9, and they also indicate the affinity to the above-named species.

It is a noteworthy fact that in the Russian Far East occurs a species closely allied to *M. sphagnorum*, which has been described by me recently under the name *Metrioptera* (*Metrioptera*) *ussuriana*, Uv. (Ann. & Mag. Nat. Hist. ser. 9, vol. xvii. 1926, p. 282, fig. 8). It has similarly-expanded last abdominal tergite in the male sex, but its lobes are more acute, and the cerci are provided with a very long spine.

It is obvious that *M. sphagnorum*, which is known only from the most northern parts of Canada, represents in the New World a faunistic element of Asiatic origin, or, to be more exact, a remnant of the Angara fauna.

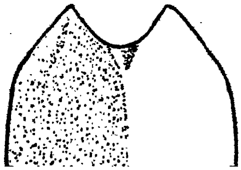
Metrioptera concinna (Walker). (Fig. 4.)

1869. *Decticus concinnus*, Walker, Cat. Derm. Salt. Brit. Mus. ii. p. 260.
1906. *Chelidoptera concinnus*, Kirby, Syn. Cat. Orth. ii. p. 212.
1908. *Metrioptera concinnus*, Caudell, Gen. Ins. 72 fasc. p. 31.

A fine species, similar in its size and general appearance [illegible], Fieb., while the pattern of the pronotum is

just as sharply pronounced as in *M. sepium* Yers., and the sides of the body are provided with broad castaneous bands. Seventh sternite of the female normal. Subgenital plate broadly trapezoidal, obtusely tectiform in transverse section;

Fig. 4.



Metrioptera concinna (Wlk.); ♀, subgenital plate.

hind margin with a semicircular excision; lobes flat, rectangular. Ovipositor short, broad, gradually recurved.

Total length 21; pronotum 5; elytra 6·5; hind femur 19; ovipositor 8 mm.

The type of this species is a unique female in the British Museum, labelled "Nepal (Hardwicke Bequest)."

XLIII.—*Descriptions and Records of Bees.*—CXXIII. By T. D. A. Cockerell, University of Colorado.

Melissodes robustior, Cockerell.

♂.—Artesia, California, at flowers of *Helianthus annuus*, var. *coronatus*, Aug. 19 (*Cockerell*).

Bombus bifarius, var. *arctostaphyli*, nov.

♀.—Hair of top of head and corbicular fringes entirely black; hair of front of head mostly black, but a large tuft of pale yellow at base of antennæ.

Calgary, Alberta, at bearberry, May 28, 1909 (*Wooley-Dod*).

Anthidium caucasicum, Radoszkowski.

Ak-Tasch Mountains, Usbekistan, June 15 and 21, 1926 (*N. Kuznetzov*).

This appears to be a valid species, though closely allied to *A. florentinum.* I have it also from Quetta, collected by Nurse.

Anthidium diadema ornatum (Lepeletier).

♀.—Scape black, red at base; pale band on vertex entire or narrowly broken; a very broad cream-coloured band occupying nearly all of axillæ and a large part of scutellum, narrowly broken in middle.

♂.—Markings bright yellow; no red. Scape yellow beneath; yellow on scutellum and at sides of mesothorax well developed. Seventh tergite orange-yellow.

Lepeletier based this on the female, from Algeria. Practically the same insect comes from the Ak-Tasch Mountains, Usbekistan, June 15 and 21 (*Kuznetzov*). One male, taken June 21, has the seventh tergite black, yellow only on the margin, and the yellow markings in general reduced; it is thus transitional to the typical form.

I have typical *A. diadema*, Latr., from Montpellier, France; the male has the scape and seventh tergite black; the scutellum and axillæ also black. It seems probable that *A. diadema caucasicum*, Friese, can be included in *A. d. ornatum*.

Anthophora atroalba erschowi (Fedtschenko).

This is a rather weak race of *A. atroalba*, Lep., distinctly smaller, the black thoracic band narrower, the second tergite with some pale hair basally. The male has the black marks on clypeus less produced laterally. I have a female from Sarepta, from the Morawitz collection, and Professor Kuznetzov has taken it in Usbekistan; both sexes at Dshilga, Apl. 22; and females in the Ak-Tasch Mts., June 15 and 19, the latter worn, and evidently at the end of their season.

In the Ak-Tasch Mts., Kuznetzov also took *A. kessleri*, Fedts. (June 15), and *A. freimuthii*, Fedts. (May 4). At Tashkent he took *A. uljaninii*, Fedts., in some numbers, both sexes March 21.

Anthophora usbekistana, sp. n.

♀.—Length about 15 mm.

Broad and robust; malar space large; tegument of face black, the tubercles of labrum castaneous; head with white hair, light fulvous on vertex and occiput; thorax above and upper part of sides with abundant long bright fox-red hair, on under side with white hair; tegulæ brownish black. Wings hyaline, faintly brownish. Legs with white hair, brown at posterior apex of middle tibiæ; spurs very dark brown; a black brush at apex of hind basitarsi. Abdomen with first tergite covered with red hair like that of thorax, second and

third with broad bands of pale red hair; fourth and beyond with black hair, but long shining white hairs projecting at sides; sternites with fringes of white hair.

In all respects very near to *A. mucida*, Gribodo (which I have from Pompei, Italy, collected by Morice), but easily distinguished by the total absence of black hairs on head and thorax above, the longer third antennal joint, and the less robust form.

3 ♀, Dshilga, Usbekistan, April 22, 1926 (*N. Kuznetzov*). The locality is a railway station about 55 kilom. north of Tashkent, in a desert country.

This is, I believe (though I cannot be positive), the species I saw in the Tashkent Museum labelled *A. caucasica*, Rad. I think Morawitz had it, and took it for *A. caucasica*, which is allied, but even more distinct than *A. mucida*. I have *A. caucasica* from Attica and Rhodus (*Morice*).

Anthophora romandii kuznetzovi, subsp. n.

♂.—Belongs to the group with labrum and greater part of clypeus bright yellow, but mandibles all black; scape broad, and yellow in front; tergites 1 to 2 white-haired (a very little black on apical part of 2), the others with erect black hair (becoming brown on sixth); middle legs simple. It runs to *A. romandii*, Lep. (which I have from Tripolis), in Friese's table, and is in fact apparently an Asiatic race of that species, differing especially by the yellow lateral face-marks being reduced to narrow bands along the orbits, from level of antennæ to near the beginning of the large malar space. Also, the legs are white-haired (dusky red on inner side of basitarsi), the hind tibiæ having a very conspicuous fringe of pure white hair posteriorly. The third tergite shows no intermixture of white hairs. The hind margins of the tergites are pallid, suffused with brown. The vertex shows black hair, but on occiput it is long and white. There is also a close resemblance to *A. caucasica*, Rad., from which it differs by the reduced lateral face-marks; the much larger and broader supraclypeal band; the broad black bands at sides of clypeus even (slightly narrowed above), not causing the yellow to be rapidly narrowed above; the more orange shade of the yellow; the much larger malar space; the black mandibles; and the broader truncation of apical plate of abdomen. As in *A. caucasica*, there is much black hair on mesothorax anteriorly, but just behind the wings the hair is long and pure white. I had to consider whether this could be the unknown male of *A. freimuthii*, but this is negatived by the slender marginal cell.

Another related species is *A. dispar*, Lep., from which the new form differs by the reduced lateral face-marks, the considerably higher clypeus, the much larger malar space, the broad end of the apical plate of abdomen, &c. The middle legs are, of course, quite different.

Ak-Tasch, Usbekistan, May 4, 1926 (*N. Kuznetzov*).

Eucera hirsuta, Morawitz.

♂.—Ak-Tasch, Usbekistan, May 4 (*Kuznetzov*).

The width of the pale clypeal band varies considerably. In Friese's key the long dorsal hair is said to be grey, but it is really lively ferruginous, giving the insect a handsome appearance. The antennæ are black.

Crocisa ramosa, Lepeletier.

♀.—Ak-Tasch Mts., Usbekistan, June 15 (*Kuznetzov*).

A widely distributed species ; I have it from Marseille (*André*).

Osmia usbekistana, sp. n.

♀.—Length 10 mm.

Olive-green, the vertex and scutellum bluish, clypeus with lower part black, and smooth median line on upper part rosy or violet ; pubescence long and loose, white, mixed with black on front and vertex, and slightly on thorax above ; abdominal tergites with long white hair all over, the margins with the tegument narrowly red, and on third and fourth with conspicuous shaggy white hair-bands ; on fifth the band is tinged with fulvous ; ventral scopa bright ferruginous. Upper part of clypeus very densely rugoso-punctate ; lower part projecting, deeply excised, with two angular projections, like the scutellum of a *Crocisa* ; mandibles broad, tridentate ; an obtuse tubercle just behind their base, under the eye ; antennæ black ; mesothorax shining, but well punctured ; scutellum with a shining median ridge ; area of metathorax dullish, not at all polished ; tegulæ bright castaneous. Wings hyaline, with a brown streak in marginal cell ; second cubital cell very long. Legs black with white hair, hind legs faintly metallic ; hair on inner side of tibia and tarsi ferruginous. Abdomen shining, well punctured. The tongue is very long.

Related to *O. emarginata*, Lep., but smaller, with pubescence differently coloured.

[illegible], Usbekistan, March 25, 1926 (*Kuznetzov*).

Megachile communis, Morawitz.

♀.—Ak-Tasch Mts., Usbekistan, June 21 and 22 (*Kuznetzov*).

It varies in size; length 7 to 10·5 mm.

There is white hair in the scutello-mesothoracic suture. The patch of white hair on the apical tergite readily distinguishes it from the similar *M. gathela*, Cam., which occurs at Deesa. In appearance this is a typical desert bee; species with the same aspect occur in the American deserts.

Megachile kengracensis, sp. n.

♀.—Length 15–17 mm. (the difference due to extension of abdomen).

Form and general characters of *M. sericens*, Fonsc., of which it may be considered a desert representative, but it is not *M. morawitzii*, Rad. Hair of face, thorax (except disc of mesothorax, which appears bare, with thin very short black hair) and broad bands of abdomen pure white; mandibles broad, quadridentate, basally with white hair but apical part with pale fulvous, and fulvous hair at apex of clypeus; cheeks very broad and rounded; clypeus rugoso-punctate, covered with hair; flagellum faintly brownish beneath; mesothorax densely and very coarsely punctured; scutellum dull; tegulæ bright ferruginous. Wings brownish hyaline, darker beyond the cells. Legs with white hair, but red on the thick tarsi, the small joints of which are red, and red also on apical part of outer side of hind tibiæ; spurs red. Abdomen rather coarsely punctured, hardly shining; sixth tergite with thin appressed fulvous hair above; ventral scopa light fulvous, brighter red on last sternite.

2 ♀, Kengrak Hills, Usbekistan, June 1, 1926 (*N. Kuznetzov*). The locality is 26 to 28 kilom. north of Tashkent.

This has perhaps been taken for *M. morawitzii*, but it is amply distinct. There is a superficial resemblance to *Chalicodoma asiatica* (Mor.).

Megachile multispinosa, Morawitz.

♂.—Kengrak Hills, Usbekistan, June 1 (*Kuznetzov*).

M. semireticulata, Cam., from Ferozepur, is probably the same species. A characteristic feature is the narrow face. The anterior coxæ have stout spines.

Xylocopa signata, Mor., var. *subjugata*, nov.

♂.—Length 17 mm.

Clypeus white, strongly punctured, the whitish lateral marks along its border small or evanescent; labrum black;

pubescence black, but occiput and thorax anteriorly with dull whitish hair; head and thorax black, the latter slightly metallic; abdomen splendidly blue, with the last two tergites obscure violaceous, and the hind margins of the other tergites variably darkened.

The supposed female runs in Friese's table exactly to *X. valga*, Gerst., but is smaller, about 22 mm. long (but some *valga* are as small), with the hair all black, and the abdomen black, not blue. *X. signata* is described by Morawitz from the male, and is said to have the thoracic hair dorsally grey, not black with a greyish band in front, as in our insect.

Ak-Tasch, Usbekistan, May 4, 1926 (*Kuznetzov*). The females were collected at the same time and place as the males. I understand that Professor Kuznetzov considers the females to belong to *X. signata*.

X. olivieri rufa, Friese, appears to be common in Usbekistan; specimens before me were collected by Kuznetzov at Tentjak-saj, May 17.

Tetralonia vernalis, Morawitz.

Tashkent, March 25, and Ak-Tasch, May 4, Usbekistan (*Kuznetzov*).

Comparing this with *T. pomona* (Nurse), from Quetta, the latter is almost the same, but has the white hair over clypeus and mouth very long and dense, and much white hair at sides of abdomen subapically. It must stand as *T. vernalis pomona*.

Cœlioxys rufescens turkestanica, Friese.

A desert form of *C. rufescens*, with white pubescence, was taken by Kuznetzov in the Ak-Tasch Mts., June 15. It is certainly the form described by Friese in 1925; he does not state how it may be separated from the much earlier *C. rufescens tricarinata* (Morawitz).

Hylæus sibiricus (Strand).

♂.—Ust Balei, July, and Smolenschina, Aug. 17, Siberia (*Cockerell*). Kindly determined for me by Mr. J. D. Alfken.

The following bees were taken by myself at the University of Wyoming Camp, Medicine Bow Range, 9600 ft. alt., Wyoming, August 1929 :—

[illegible] Cresson.

[illegible] (Cresson), ♀.—This differs from *C.*

elegans (Cresson) by the less densely punctured disc of mesothorax; mesothorax black except broadly in front and very narrowly behind; scutellum black. The species was described from California, but the Wyoming insect certainly appears conspecific.

Osmia (*Cephalosmia*) *armaticeps*, Cresson.

Osmia nelsoni, sp. n., ♀.—Length about 10 mm., anterior wing 6·5. Rather narrow, with parallel-sided abdomen; head and thorax dark blue, closely punctured, the vertex and scutellum greenish; abdomen shining bright steel-blue, rather weakly punctured; hair of head all black, except some long white hairs on occiput, black hair of front very long; thorax with black hair, but mesothorax and scutellum with long silvery-white hair, and some black intermixed; tegulæ black, with a dark reddish boss. Wings brownish hyaline. Legs black, with black hair; spurs black. Abdomen with short black hair, but first tergite with very long dull white hair at sides; ventral scopa black (in the type full of sulphur-coloured pollen). Mandibles strongly tridentate; cheeks very broad, only faintly metallic; face rather narrow; clypeus densely punctured, without any smooth line, the apex produced, shining in middle and broadly emarginate, obtusely subangulale at each side of the emargination; small shining tubercles at basal corners of mandibles; front very densely punctured, distinctly blue; mesothorax closely punctured, but sparsely on disc posteriorly; scutellum with no smooth line, area of metathorax entirely dull.

Named after Prof. Aven Nelson, of the University of Wyoming, who by his researches and teaching has been the inspiration of innumerable students.

In the tables of Californian and Canadian species by Miss Sandhouse, this runs to *O. faceta*, Cress., a very different species with white hair on pleura. The peculiar clypeus, comparatively narrow form, and steel-blue abdomen will readily distinguish it.

Bombus (*Pratobombus*) *centralis juxtus* (Cresson). — At flowers of *Delphinium barbeyi*, Huth.

Bombus (*Alpinobombus*) *kirbyellus*, Curtis.—At flowers of *Delphinium barbeyi*.

Megachile wootoni, Cockerell, male.

Megachile geophila, Cockerell, female.

Andrena apacheorum, Cockerell, females.

Colletes oromontis, Viereck, females.

Hylæus ellipticus, Kirby, females.

Halictus peraltus, Cockerell, males.

XLIV.—*Corrections to my Paper "Studies on the Trematode Family* Heterophyidæ." By G. Witenberg, Department of Parasitology, The Hebrew University, Jerusalem.

After the issue of my recent paper*, Prof. M. Hall of the U.S. Dept. of Agriculture called my attention to the following errors in nomenclature :—

(1) The genus *Adleria*, which is established in this paper, is preoccupied by *Adleria*, Rohwer & Fagan, 1917, for an insect. I therefore propose to change this name into *Adleriella*, with the type-species *Adleriella minutissima* (Witenberg, 1929), and hence substitute Adleriellinæ instead of Adleriinæ.
(2) I used *Ascocotyle agrense* instead of *A. angrense*.
(3) I used the generic name *Monorchitrema* for *Monorchotrema* and *Monorchitrema taihui* for *Monorchotrema taichui*.

I must, however, emphasize that I no longer hold it necessary to retain the genus *Monorchotrema* as valid. Its type-species, *Monorchotrema taihokui*, Nishigori, 1924, is undoubtedly a synonym of *Haplorchis pumilio* (Looss, 1896). The type-specimen of the latter species is apparently lost; nevertheless, the identity of these two species is evident, because their original description fully corresponds to that of my material. The dissimilarity of hosts of these two species cannot be regarded as proof that they are distinct, for it is already sufficiciently proved that species of Heterophyidæ may parasitise both animals and birds.

Hence the generic name *Monorchotrema*, Nishigori, 1924, falls into synonymy in favour of *Haplorchis*, Looss, 1899, and thus the second species of this genus should be called *Haplorchis taichui* (Nishigori, 1924).

On the other hand, *Haplorchis cahirinus* (Looss, 1896) must be excluded from the genus *Haplorchis* because of its long præpharynx and the advanced position of the testis. Its systematic position may, however, be determined only after the redescription of this species, for its occurrence in a fish is unusual among Heterophyidæ and suggests that it does not belong to this family.

While my paper was still in print a paper of Travassos appeared † in which this author points out that, according to the Rules of Nomenclature, the generic name *Phagicola*, Faust, 1920, should be used instead of *Parascocotyle*, Stunkard & Haviland, 1924, which I employed. This view

* Annals Trop. Med. & Paras. vol. xxiii. no. 2 (1929).
† Comptes Rend. Soc. Biol. vol. c. no. 7, pp. 939–940 (1929).

may be correct, but the matter cannot be settled until we have a redescription of the type-species, *Phagicola pithecophagicola*, Faust, 1920. According to the original description, which is insufficient, this species lacks the cone-shaped appendage of the oral sucker, and might therefore be placed in a separate genus *Phagicola*, Faust, distinct from both *Ascocotyle* and *Parascocotyle*. I examined the type-material of *Phagicola pithecophagicola* mounted on a slide, kindly lent me by Prof. Faust, but, owing to unsuitable mounting, I was not able to trace any more details than are given in the original description. Therefore only a redescription of a new material of *Phagicola pithecophagicola* can settle the question whether *Parascocotyle* is synonymous with *Phagicola* or whether they both are valid genera.

In my paper (p. 138) I established a new superfamily Opisthorchoidea, to include the families Opisthorchidæ and Heterophyidæ. Several days before the issue of my paper (April 11, 1929), the manual of Human Helminthology of Faust appeared, in which a superfamily Opisthorchoidea was established, but with another interpretation—it does not contain the family Heterophyidæ, which is attributed to a distinct superfamily Heterophyoidea.

It is clear that Faust's name takes precedence over mine, but the interpretation of its contents requires further confirmation. In a letter of September 28th, Prof. Faust writes to me: "When I came to the study of the excretory system of these two families, and, furthermore, found that the miracidia of the former (Heterophyidæ) were bilaterally symmetrical in internal structure, while those of the latter family (Opisthorchidæ) were asymmetrical, I was forced to conclude that these two families were fundamentally different." Prof. Faust adds that he has found "abundant proof in all stages of development in the two respective families to bear out my thesis."

It seems to me, however, that the significance ascribed to these organs by this author is not fully justified. The mentioned differences in the structure of excretory organs are important in differentiation of small groups, as for instance genera, but not superfamilies, especially when one deals with a family like Heterophyidæ, in which the structure of excretory apparatus in adult worms presents so many variations.

After restudying the available material of the genera *Rossicotrema*, Skrjabin, and *Tocotrema* (Looss), I concluded that they shall not be regarded as distinct ones, as they are

presented in my paper. The differences between their representatives are rather of specific value, not greater than between say *Parascocotyle longa* (Ransom) and any other species of the genus *Parascocotyle*, i. e., in the number of gonotyls. I therefore find it suitable to regard the genus *Rossicotrema* as synonym of *Jocotrema*.

XLV.—*Thysanoptera from South Africa.*

By Dudley Moulton.

This brief paper includes the description of one new species and records of three others, all belonging in the Tubulifera. The collections were forwarded to me through the courtesy of Mr. Frederick Laing of the British Museum, London, and the type of the new species is being deposited with that institution. The specimens were collected in South Africa by Mr. R. E. Turner. I wish to express my appreciation to both Mr. Laing and Mr. Turner for their interest and co-operation.

Genus Bactrothrips, Karny.

The three genera *Bactrothrips*, *Bactridothrips*, and *Eidothrips* are differentiated by the horned processes on the abdominal segments of the male. The processes on the sixth segment in *Bactridothrips*, as described by Karny, are rather long and horn-like and those on the seventh and eighth tooth-like, those on 8 being longer than the ones on segment 7. In *Bactrothrips* the horn-processes on the sixth segment are shorter and 7 and 8 have swellings which are not tipped with teeth on the species described up to this time. *Eidothrips* is distinguished by having the large horn-like processes placed on the fifth abdominal segment, a shorter pair on the sixth, and the posterior angles of the ninth with swellings, each tipped with a thorn-like bristle.

I find no clearly defined characters of generic importance to separate the genera in the material before me when female specimens alone are studied. The new species which I am describing herewith from a single male specimen has the long horned processes on the sixth abdominal segment, swellings only on the seventh, and clearly defined tooth-like projections on the eighth. This places the new species in an intermediate position between the genus *Bactrothrips* and *Bactridothrips*, in so far as specimens of these two groups

have been described. I am inclined to believe that the characters of the male should be recognised only as of specific value, but should like to have more material for study before reducing either genus *Bactridothrips* or *Eidothrips* to synonyms of *Bactrothrips*.

Bactrothrips natalensis, sp. n.

Male holotype.—Colour blackish brown including all legs, tarsi brown, body with reddish-orange pigmentation. Third and fourth antennal segments yellow, shading to light yellowish brown in distal enlarged portions, other segments dark brown except basal half of 6 which is brown. Wings clear except basal portions, including scale and veins which are brown and a slight shading of yellowish brown around outer margins. All prominent body-spines clear yellow.

Total body length 5·5 mm.; head, length ·63 mm., width across eyes ·28 mm., across cheeks ·29 mm.; prothorax, length ·235 mm., width, including coxæ, ·529 mm.; pterothorax width ·78 mm. Abdominal segments: length (width) vi. ·323 (·617) not including swelling; vii. ·338 (·38); viii. ·338 (·308) not including teeth; ix. ·279 (·235). Tube, length ·97 mm., width near base ·102 mm.; length of processes on sixth segment ·47 mm., on eighth segment ·073 mm. Antennæ: length (width) i. 60 (60); ii. 73 (43); iii. 63 (46); iv. 290 (46); v. 253 (33); vi. 186; vii. 83; viii. 86; total length 1370 microns. Length of spines: anteocellar 86 μ; postocellar 50 μ; basal spines 83, 66, and 220 μ respectively.

Head 2·2 longer than width at eyes, the projection in front of eyes short but distinct; cheeks narrowed behind eyes and swollen in posterior third. Interocellar spines distinct and about as long as width of eyes, postocellar somewhat shorter. Two pairs of postocular spines short and blunt and about equal in length to the cheek-spines immediately behind eyes. Eyes large, sub-ovate, not protruding. Posterior ocelli contiguous with centre inner margins of eyes, anterior ocellus near bases of antennæ. Mouth-cone short and broadly rounded. The third antennal segment long and narrowed, enlarged only at distal end, four swollen in outer third and five swollen in outer half. Sense-cones long and pointed.

Spines along anterior margin of prothorax short, those at anterior angles placed well back from anterior margin and close to mid-laterals, posterior angle spines present but broken from the single specimen before me. All prominent spines with blunt tips. Oblique sutures at posterior angles

after being fused and bending backward ending abruptly at bases of inner spines. Pterothorax sub-quadrate. Metanotum with a pair of long slender spines. Legs slender, fore tarsi unarmed. Wings slightly enlarged beyond middle, median veins distinct and ending abruptly near centre, first and second basal wing spines short, the third approximately three times longer than the others.

Abdomen with segment 6 transverse, 7 about as wide as long, and 8 and 9 longer than wide. Segment 6 with a distinct pair of horn-like processes, 7 with a swelling on either side of distal third, 8 with a tooth-like process on either side, and 9 without processes but with a slight swelling on either side near posterior margin which is armed with a sharp, moderately stout bristle. Tube 1·35 longer than head, distinctly setose in basal three-fourths and more sparingly distally.

Type-material.—Holotype taken from an unknown host-plant May 3, 1926 (*R. E. Turner*), and deposited with British Museum (Moulton No. 2842).

Type-locality.—Eshowe, Zululand, South Africa.

This species seems most closely related to *Bactridothrips laingi*, Bagnall, but is separated by the uniform brown colouring of the legs, in *laingi* the tips of the tibiæ and tarsi are yellow. This species is also distinct from *laingi* by the absence of a tooth-like process on the seventh abdominal segment of the male.

Bactridothrips laingi, Bagnall.

One female, two male specimens, and one broken specimen taken at Eshowe, Zululand, and one female at Kloof, Natal, South Africa, in June, July, and August 1926 (*R. E. Turner*). Host-plants unknown (Moulton Nos. 2885, 2886, 2906, and 2911).

Eidothrips alluaudi, Bagnall.

Three female specimens taken from an unknown host-plant at Eshowe, Zululand, South Africa, in April 1926 (*R. E. Turner*) (Moulton Nos. 2912, 2913, and 2914).

Gigantothrips caudatus, Bagnall.

One ♀ and two ♂ ♂ specimens taken from an unknown host-plant at Port St. John, Pondoland, South Africa, in [illegible] 1923 (*R. E. Turner*) (Moulton Nos. 2927, 2928,

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XLVI.—*On some Ammonoidea from the Lower Greensand.*

By L. F. Spath, D.Sc., F.G.S.

[Plates XIV.–XVII.]

Contents.

I. Introduction.

Since Forbes, in 1845, described* some new ammonites from the Lower Greensand (one of which is now figured for the first time) few papers dealing with British Aptian cephalopods have appeared. Keeping †, in 1883, illustrated a few Upware examples, but no additional forms have been figured in this country except Crick's *Ammonitoceras tovilense* ‡; and the lack of ammonite names is severely felt by workers on the Lower Greensand and by museum curators alike. I wrote, in 1925 §, that I hoped shortly to publish a preliminary account, with a few plates, of new or little known Aptian ammonites, based partly on a fine series of Hythe examples which the Keeper of the Manchester Museum, Mr. J. Wilfrid Jackson, had been good enough to lend me, through the kind intervention of Prof. D. M. S. Watson, F.R.S. The publication of the paper was deferred since Mr. A. Perl, B.Sc., of Hove, was then engaged in zonal collecting in the Isle of Wight, and it was hoped that he would be able to publish his stratigraphical results in the meantime. Mr. Perl has, however, now kindly given me his material, and other specimens were presented by Mr. E. H. Crinage, of Ventnor, or were lent by various museums, to the authorities of which the writer expresses his grateful acknowledgments. The present paper is thus now offered as a preliminary account of the Lower Greensand ammonites, pending the publication of a fuller monograph. There are a number of workers on the Weald Research Committee of the Geologists' Association investigating the Lower Greensand in the circum-Wealden area, and it is hoped that the account will facilitate local and regional correlation of faunas. It may be added that there are yet some incompletely known smaller forms, *e.g.*, from the Wicken Beds, and a certain number of unnamed larger species from the Bargate Stone of Surrey, the Ferruginous Sands of the Isle of Wight, and from Seend in Wiltshire that require description. They must await an opportunity for adequate illustration, since reduced figures of large ammonites are generally misleading, and the writer's 'Monograph of

* "Catalogue of Lower Greensand Fossils &c.," Quart. Journ. Geol. Soc. vol. i. (1845), pp. 237–50, pp. 345–55, pl. v.

† 'The Fossils and Palæontological Affinities of the Neocomian Deposits of Upware and Brickhill' (Cambridge, 1883).

‡ "On *Ammonitoceras tovilense* from the Lower Greensand (Aptian) of Kent," Proc. Malac. Soc. vol. xii. 1916, pp. 118–120, pl. vi.

§ Spath, in Walton, 'Folkestone and the Country Around,' 1925, p. 31.

the Gault Ammonites,' now being published by the Palæontographical Society, will have to be completed before a full account of the Lower Greensand ammonites can be thought of. Recent French works, like those by Kilian, Kilian and Reboul, and Roch, repeatedly quoted below, will be found useful; but Dr. Corroy's * 'Revision of the Aptian Fauna of the Eastern Border of the Paris Basin,' including many of the common English forms, is too brief, and no ammonites are illustrated.

Morris, in the second edition of his Catalogue (1854), listed twelve species of Lower Greensand Ammonoidea. The total is now brought up to fifty, not counting some unnamed forms briefly referred to in this note. But the ammonite fauna of the Lower Greensand as a whole must be considered an impoverished one. This is shown not only by the fact that in many collections it is represented only by the single species *Deshayesites deshayesi* (Leymerie), but there is also a total absence of such widely-spread genera as *Aconeceras* and *Sanmartinoceras*, not to mention the fundamental *Phylloceras* and *Lytoceras*, and the equally important Desmoceratidæ, dominant in Aptian times in Mediterranean regions. I previously † discussed the probability of the migration of *Aconeceras* (found at Speeton) from north to south, but I hope to deal with the distribution of Aptian ammonites when revising the Kachh forms. In that description will also be incorporated an account of the unpublished Barremian and Lower Aptian ammonites from the Tendaguru region in Tanganyika Territory received since I referred to this fauna in 1921 ‡.

The need for a revision of the British Aptian belemnites and nautili is not so pressing. The former are mostly fragmentary and largely indeterminable, except, perhaps, in the Wicken Beds. The nautili are common, but mostly belong to the two species *Cymatoceras radiatum*, J. Sowerby, sp. §, and *C. pseudoelegans* (d'Orbigny). *Anglonautilus undulatus* (J. Sowerby) of the *nutfieldiensis* beds is generally incomplete, and *Eucymatoceras plicatum* (Fitton) || and,

* 'Le Néocomien de la bordure orientale du bassin de Paris,' Nancy, 1925, pp. 1–334, pls. i.–xii.

† "Cretaceous Cephalopoda from Zululand," Ann. S. Afr. Mus. vol. xii. pt. 7, no. 16, 1921, p. 310.

‡ *Ibid.* p. 311.

§ See Foord and Crick, "Nautili &c.," Ann. & Mag. Nat. Hist. (6) vol. v. 1890, p. 398.

|| Also recorded from Saint-Dizier and Gurgy, Yonne, France (in Corroy, *loc. cit.* [Neocomien Bassin, Paris, 1925], p. 307). Foord ('Catalogue of Fossil Cephalopoda in the British Museum,' vol. ii. 1891, p. [illegible] to be "well represented," but there are still only five specimens [illegible]

Heminautilus saxbyi (Morris) are known in only a few individuals. *Eutrephoceras sublævigatum* (d'Orbigny), recognized by Crick in the Lower Greensand of Seend and Faringdon, represents another rare type.

II. Correlation of the Aptian.

In this connexion it may be advisable to refer to the zones of the Aptian, previously put forward * and discussed by Dr. Neaverson † in his new admirable Text-Book. The lowest zone, corresponding to what has been called the Parancyloceratan age, may be provisionally named the *rectecostatus*-zone; for *Costidiscus* of the *rectecostatus* type were previously listed ‡ as characterizing beds above the true (Mediterranean) Barremian or uppermost Neocomian.

It is true that *Costidiscus*, like its close ally *Macroscaphites*, occurs already in the Upper Barremian; but according to Kilian § *Costidiscus rectecostatus* (d'Orbigny), var. *crassa*, Kilian, is far commoner in the Lower Aptian (Bedoulian) than in the Barremian, while *Macroscaphites striatisulcatus*, occurring with the former, is also much more abundant in the Aptian than *M. ivanii*, which has its maximum development at the top of the Barremian. There, however, they are associated with a fauna which is quite different from that of the Lower Aptian, characterized by the sudden development of the early Cheloniceratids. It ought to be mentioned in this connection that the so-called "*Macroscaphites*" of the Isle of Wight (*e.g.*, "*M.*" *gigas*, quoted as recently as 1921 ‖) have nothing in common with the true *Macroscaphites* just mentioned except a certain similarity of coiling. Similarly, *Crioceratites* (generally but wrongly written "*Crioceras*") does not occur in the Lower Greensand.

The true *Ancyloceras* (group of *A. matheronianum*, d'Orbigny) is also typically Lower Aptian. Unfortunately it is known apparently in only a single British example (Mantell's original ¶) from the *Perna* bed of Atherfield, and

* Spath, "On the Ammonite Horizons of the Gault and Contiguous Deposits," Summary of Progress for 1922, Mem. Geol. Survey, 1923, p. 148.

† 'Stratigraphical Palæontology,' London, 1928.

‡ Spath, "Ammonites of the Speeton Clay and Subdivisions of the Neocomian," Geol. Mag. vol. lxi. 1924, p. 80 (table iii.).

§ In Frech, 'Lethæa Geognostica,' ii. Mesozoicum, 3 Kreide, part i. Lief. 2 (1910), p. 253.

‖ "Geology of the Isle of Wight," H. J. Osborne White, Mem. Geol. Survey, p. 28.

¶ See 'Geological Excursions in the Isle of Wight,' 2nd ed., 1851, p. 444, fig. 41 (B.M. no. C. 3748, ex S. H. Beekles Coll.). Judd, however, in 1871 ("Punfield Formation," Quart. Journ. Geol. Soc. vol. xxvii. p. 220), recorded *Ancyloceras* from immediately above the Wealden Paper Shales and below the *Perna* Bed of Sandown Bay.

to show that correlation is as yet far from exact I may mention that there are as yet only two ammonite fragments (*Procheloniceras*?) known from the overlying (true) Atherfield Clay. Adopting Mr. Osborne White's * divisions of the Lower Greensand succession in the Isle of Wight, I correlated the *Perna* Bed (I.) with the lower *deshayesi* zone, *Deshayesites deshayesi* being listed from this bed as well as from the true Atherfield Clay (II. *a*). These records, however, are doubtful. *Deshayesites*-like forms occur low in the Lower Aptian, *e.g.*, Roch † has them from a number of beds below the maximum occurrence of the typical *D. deshayesi* (his bed 6), which latter seems to correspond to my *hambrovi*-subzone. The other subdivisions previously listed were named after forms occurring in the Speeton–Hanover succession only in default of better species; for *Ancyloceras matheronianum* (of the *Perna* Bed) has too large a range at Bedoule, and the two *Procheloniceras*? fragments known so far from the (restricted) Atherfield Clay are obviously insufficient for exact correlation.

The names *weissi* and *bodei* adopted from Stolley ‡ must thus still be considered as merely provisional labels. The basal bed of the Hunstanton Carstone had yielded species (e.g., *Dufrenoyia*) of the higher "*consobrinoides*"-zone as well as *Deshayesites* of the *bodei* type, and thus represents a condensed deposit with forms of more than one horizon from the lower *deshayesi*-zone (if Stolley's placing of *bodei* is correct) up to the Upper Aptian. In the *Perna* Bed of Woodhatch, near Reigate, Surrey §, *Deshayesites* of the *læviusculus* type occur, not identical with those found at Hunstanton, and neither these and the associated *D. bodei*, *D.* sp. n. aff. *tenuicostatus* (v. Koenen), and *D. fissicostatus* (Phillips) of Norfolk and Yorkshire, nor the typical *D. weissi* (Neumayr and Uhlig), have yet been found in the Isle of Wight.

The Lower Lobster Bed (II. *b*) has yielded abundant

* *Loc. cit.* (1921), p. 27, II. *a* = Atherfield Clay, s. s. [70 ft.], II. *b* = Lower Lobster Bed [30 ft.], III. *a* = Crackers, s. s. [20 ft.], III. *b* = Upper Lobster Bed [40 ft.].

† "Etude Stratigraphique et Paléontologique de l'Aptien inférieur de la Bedoule," Mém. Soc. géol. France, n. s., vol. iv. p. 7.

‡ Centralblatt f. Mineral. &c., 1908, p. 220. See Spath, "Cret. Cephalopoda from Zululand," Ann. South Afr. Mus. vol. xii. no. 7, 1921, p. 311. I pointed out in 1924 (Geol. Mag. p. 85) that Stolley wrongly placed the Aptian of Ahaus below instead of above the *deshayesi*-zone, and it is not impossible that he misinterpreted *D. weissi*.

§ G. W. Butler, "On the *Perna* Bed and the Weald Clay of Reigate," Proc. Geol. Assoc. vol. xxxiii. (1922), p. 316.

typical *Deshayesites deshayesi* and allies, also *Cheloniceras hambrovi* (Forbes), but in the succeeding Crackers (III. *a*) the same forms still occur, with examples of what seems to be the true, evolute, and coarsely ribbed *P. consobrinus* (d'Orbigny). The Upper Lobster Bed (III. *b*), also very fossiliferous, yielded the pyritized example of *Deshayesites* referred to below and figured in Pl. XVII. fig. 5, whilst in bed IV. (Lower *Gryphæa* Bed = wrongly "*consobrinoides*" horizon) the form figured in Pl. XVII. figs. 1–2 (*D. grandis*, sp. n.) is dominant. The *Deshayesites* of these top beds of the Lower Aptian, taken to correspond to bed 8 of Roch's Bedoulian, often grow to a very large size, and persist into the Upper Aptian.

The succeeding beds (V. to X.), with a thickness of over 200 feet, are characterized by species of *Tropæum*, notably the hooked *T. hillsi* and *T. gigas* below, and the more closely coiled *T. bowerbanki* above. In the Isle of Wight the next higher beds of the Ferruginous Sands (XI. to XIV.) have yielded only rare *Cheloniceras* of the *subnodosocostatum* group, and in the succeeding Sandrock Series, which may include Upper Aptian as well as the lowest Albian, ammonites are almost unknown. The few fragments in our public collections that may have come from these upper beds in the Isle of Wight are not only insufficiently labelled, but too poorly preserved for definite identification. Moreover, the Upper Aptian *Cheloniceras* of the *martini* group are not only closely allied to the earlier (Lower Aptian) forms of the *cornuelianum*-type, but *Ch. subnodosocostatum* (which is very similar to Forbes's *Amm. martini*) directly connects with *Diadochoceras nodosocostatum* of the Lower Albian. The few hundred feet of British deposits of this period represent a fairly rapid accumulation, and the subzones previously given are probably quite sufficient to accommodate the faunas so far known from other areas. There is as yet nothing comparable to the Lower Albian fauna, with forms of the *clansayense*-group from the Luitere Zug, described by Jacob and Tobler*; and the correlation of the Folkestone Sands or uppermost member of the Lower Greensand series is as uncertain as that of the Sandrock of the Isle of Wight. Both, however, are succeeded by the Middle Albian *mammillatus*-zone in most places, and the slightly earlier *Leymeriella* fauna is at present known only from Leighton

* "Gault de la Vallée de l'Engelberger Aa," Mém. Soc. Paléont. Suisse, vol. xxxiii. 1906, pp. 1–26, pls. i., ii. Natzki (" Stratigr. Unt. Kreide Mangyschlak," Mat. Géol. Russie, vol. xxvi. 1918, p. 189), put these *nolani*-beds into the Upper Aptian.

Buzzard in Bedfordshire and (in a single example) from Berwick Common, near Lewes, Sussex. The Lower Greensand at the latter locality, according to H. J. Osborne White *, has phosphatic nodules in a top bed. No ammonites seem to have been found "*in situ*" in this bed, and it was thus provisionally assigned to the *mammillatum*-zone.

III. Specific Descriptions.

Family I. **Parahoplitidæ**, Spath, 1922.

Genus Deshayesites, Kazansky, 1914 †.

1. *Deshayesites deshayesi* (Leymerie MS.), d'Orbigny sp.

1841. *Ammonites deshayesi*, Leymerie MS.; d'Orbigny, Pal. Franç. Terr. Crét. i. p. 288, pl. lxxxv. figs. 1, 2, *non* 3.
1842. *Ammonites deshayesi*, Leymerie, Mém. Soc. Géol. France, (1) vol. v. pl. xvii. fig. 17.
1845. *Ammonites deshayesi*, Leymerie; Forbes, *op. cit.*, Quart. Journ. Geol. Soc. vol i. pl. xiii. fig. 2.
1875. *Ammonites deshayesi*, Leymerie; Topley, Geology of the Weald, p. 421.
1914. *Hoplites* (*Deshayesites*) *deshayesi*, Kazansky, pars, "Description Céphal. Crét. Daghestan, etc.," Tomsk. Izv. Technol. Inst. vol. xxxii. no. 4, p. 100.
1926. *Deshayesites deshayesi* (Leymerie), Renngarten, "Faune Dépots Crétacés &c.," Mém. Com. Géol. n. s., livr. cxlvii. p. 100.
1927. *Parahoplites deshayesi* (Leymerie); Roch, *op. cit.*, Mém. Soc. Géol. France, n. s., vol. iv. p. 15.

The example figured by Forbes (M.P.G. no. 2289, ex Geol. Soc. Coll.) is considered typical. The species does not grow to more than, say, 80 mm. diameter, but there are slightly more densely and more distantly ribbed, also evolute and involute varieties, connecting this species with its allies. There may occasionally be difficulty in distinguishing the young of the latter: the immature specimen referred to by Lamplugh ‡ as one of the "*Ammonites knaptonensis*" in the Bean Collection (B.M. no. C 4652), and said to come from "Yorkshire," is one of these indefinite forms of the *deshayesi* group; it almost certainly also is from Atherfield, and thus cannot be one of Bean's originals.

* "Geology of the Country near Lewes," Mem. Geol. Survey, Sheet 319, 1926, p. 35.

† = "*Parahoplitoides*," Spath, "Cretaceous Ammonoidea from Angola," Trans. Roy. Soc. Edinburgh, vol. liii. pt. 1 (no. 6), 1922, p. 111. *Deshayesites* and *Dufrenoyia* are somewhat intermediate between the Hemihoplitidæ, Spath, and the typical Upper Aptian *Parahoplites*, s. s.

‡ 'Naturalist,' Nov. 1890, p. 2.

The example figured by Prestwich * (B.M. no. 70520) is a less typical *D. deshayesi*; the illustration shows the ribbing somewhat too coarse, which suggests reference to *D. consobrinoides*. At that small diameter, however, the varieties above mentioned cannot yet be satisfactorily distinguished. Kilian †, who also accepted Forbes's example as typical, separated from the present species the small ammonites figured by Neumayr and Uhlig ‡ and by v. Koenen § as *Hoplites deshayesi*, and renamed (var. "*rhodanica*") the large example illustrated by the former authors ||, although this had already been separated by Sinzow ¶ under a new name. In reality both the small specimens just mentioned are difficult to separate from the true *D. deshayesi*, although one is here referred to *D. consobrinoides*, discussed below, and the other is considered to connect the *deshayesi*-group with the earlier *D. fissicostatus* and allies, known in England only from Speeton, Wicken, and the Hunstanton Carstone.

Parahoplites weerthi, Simionescu ** (=*Ammonites* (*Hoplites* ?) *uhligii*, Weerth ††, non Anthula), which superficially resembles the much smaller var. *densicostata* of the present species (*e.g.*, B.M. no. C 24717), does not even belong to the genus *Deshayesites*.

Horizon and Localities.—Lower Aptian, middle *deshayesi*-zone (especially beds II *b* and III *a*), Isle of Wight, Kent, Surrey, ? Wicken, Cambs.

2. *Deshayesites* aff. *latilobatus* (Sinzow).

1881. *Hoplites deshayesi* (non Leymerie), Neumayr and Uhlig, *op. cit.* Palæontogr. vol. xxvii. p. 177, pl. xlv. figs. 1 *a*, *b*.
1909. *Parahoplites latilobatus*, Sinzow, *op. cit.* Russ. Kais. Min. Ges. (2) vol. xlvii. p. 3.
1913. *Parahoplites deshayesi*, var. *rhodanica*, Kilian, *loc. cit.* (Lethæa), pp. 301, 344, 345.

* 'Geology,' vol. ii. 1888, pl. x. fig. 2.
† *Loc. cit.* (Lethæa, 1913), p. 344.
‡ "Ammonitiden aus den Hilsbildungen Norddeutschlands," Palæontographica, vol. xxvii. 1881, p. 177, pl. xlvi. fig. 3.
§ "Ammonitiden des Norddeutschen Neocom.," Abhand. K. Preuss. Geol. Land.-Anst., N. F., Heft xxiv. 1902, p. 204, pl. xiv. figs. 10 *a*, *b*.
|| *Loc. cit.* 1881, pl. xlv.
¶ "Beiträge zur Kenntnis des Südrussischen Aptien und Albien," Verhandl. Russ.-Kais. Mineral. Ges. St. Petersburg, ser. ii. vol. xlvii. 1909, p. 3.
** "Synopsis des Ammonites Néocomiennes," Trav. Lab. Géol. Grenoble, vol. v. (1899–1900) 1901, p. 654.
†† "Fauna des Neocomsandsteins im Teutoburger Wald," Pal. Abhandl. vol. ii. 1884, p. 22, pl. vii. fig. 1.

1915. *Parahoplites consobrinoides* (Sinzow ?), Kilian and Reboul, "Aptien Inférieur de Montélimar," Mém. Explic. Carte Géol. Dét. France, p. 40.

1927. *Parahoplites deshayesi*, var. *consobrinoides* (Sinzow), Roch, *op. cit.* Mém. Soc. géol. France, n. s., vol. iv. p. 15.

This form was differently interpreted by Sinzow and Kilian, the latter even stating that it differed from the typical *D. deshayesi* in its coarser ribs, whilst Sinzow showed that it had finer and more numerous ribs. At a later date Kilian united his var. *rhodanica* definitely with *D. consobrinoides* *, Sinzow, and he was followed in this by Roch; but if Trautschold's Russian example be taken as typical of the latter species, the present form must be kept entirely distinct. Kilian also was wrong in uniting with the present form both v. Koenen's † small example and Neumayr and Uhlig's ‡ coarsely ribbed specimen. This, however, is probably identical with *D. consobrinoides*, as I understand it, whilst v. Koenen's example is a much more finely ribbed form intermediate between *D. fissicostatus* and the true *D. deshayesi*.

Taking Neumayr and Uhlig's large form as typical, we note that the trifid or even multiplicate ribs persist to a considerable diameter, which indicates affinity with *D. weissi* (Neumayr and Uhlig). The two forms, however, cannot be united in one species, as is done by Roch §, who would keep distinct a var. *latilobata*, whilst referring the type of this same variety, namely, Neumayr and Uhlig's large *Hoplites deshayesi*, to the typical *D. weissi*. In any case, the last is an early form, with resemblance to the later *D. grandis*, but a less truncate periphery and ribs that show a distinct forward sinus on the periphery, but no flattening. The only British example (B.M. no. 48836) that can be compared to this restricted *D. latilobatus* is transitional in this respect to *D. grandis*, and also comes from an intermediate horizon (probably III *a*). It, however, also shows a tendency to smoothness and a more rounded whorl-shape which links it equally with the still more inflated *D. topleyi* and the more distantly ribbed *D. kiliani* from the same bed. The finely ribbed varieties of *D. deshayesi* are much more evolute.

Horizon and Locality.—Lower Aptian, middle *deshayesi*-zone (II *b* to III *b*?), Atherfield, Isle of Wight.

* "Bemerkungen ueber einige Ammoniten des Aptien," Odessa, 1890, pl. A, figs. 8–10 (*fide* Roch, 1927, p. 15). This work does not appear to be in any English library.

† [illegible] (Ammonitiden norddeutsch. Neocom.) pl. xlv. fig. 10.

‡ [illegible] (1881) p. 179, pl. xlvi. figs. 1, 1 *a*.

§ [illegible] (1927) p. 17.

3. *Deshayesites consobrinoides* (Sinzow), Kilian sp.

1898. *Hoplites consobrinoides*, Sinzow, Ammoniten des Aptien, Odessa, pl. A, figs. 8–10 (*fide* Roch).
1913. *Parahoplites consobrinoides*, Sinzow; Kilian, *loc. cit.* (Lethæa), p. 344.
1927. *Parahoplites deshayesi* (Leymerie), var. *consobrinoides*, Sinzow; Roch, *op. cit.* (Mém. Soc. Géol. France, n. s. vol. iv. p. 15).

This species differs from the typical *D. deshayesi* merely in the coarseness of its ribbing. In the absence of Sinzow's original account I interpret it with the help of Trautschold's * figure and the small ammonite figured by Neumayr and Uhlig †, and identified by Kilian ‡ with the present species. It seems fairly common at Atherfield, and is connected with the flat *D. deshayesi* of the same beds by a number of transitions, just as the two species occur together in Russia.

When using the term "*consobrinoides*-subzone" § I had in view chiefly forms like *D. grandis*, which seemed to me then referable to Kilian's "var. *rhodanica*" of *D. deshayesi* [now *D. latilobatus*, Sinzow], whose interpretation I accepted. *Deshayesites consobrinoides*, as now understood, has a range identical with that of *D. deshayesi*, so that it is common only in beds below the upper part of the *deshayesi*-zone, s. l.

A very fine specimen of this species (B.M. no. 46587) from Mr. Saxby's collection measures 112 mm. in diameter, and is complete to the mouth-border. Unfortunately the peristome suffered damage during the life of the animal, and was subsequently repaired, with resulting asymmetry. This form resembles *Colombiceras waageni*, sp. n. (=*Ammonites deshayesi*, non Leymerie in Waagen ||), with more pronounced anguliradiation.

Horizon and Locality.—Lower Aptian, middle *deshayesi*-zone (especially II *b* and III *a*), Atherfield, Isle of Wight.

4. *Deshayesites grandis*, sp. n. (Pl. XVII. figs. 1, 2.)

Type.—An example (no. 2300 Geol. Soc. Coll.) from Atherfield (probably bed IV or V) in the Museum of Practical Geology.

Diagnosis.—Coiling subplaty-, subleptogyral, subangustumbilicate; whorl-sides flattened, with region of greatest whorl-thickness just below the middle; venter narrowly arched to

* "Der Inoceramen-Thon von Ssimbirsk," Bull. Soc. Imp. Natur. Moscou, vol. xxxviii. (1865), p. 22, pl. iii. figs. 16 *a–c*.

† *Loc. cit.* (1881) pl. xlvi. fig. 3.

‡ *Loc. cit.* (Lethæa, 1913) p. 344.

§ *Loc. cit.* (Summary Progress, 1923) p. 147.

|| "Jurassic Fauna of Kutch," vol. i. pt. 4, Pal. Indica, ser. ix. no. 4, 1875, p. 246, pl. lx. (corrected plate) figs. 2 *a*, *b*.

subtabulate. Distinctly falcoid ribs, irregularly bi- or trifurcating, and with long or short, coarse or fine, intercalated ribs. Slight peripheral flattening and scarcely distinct forward sinus. Umbilicus opening out in adult when ribs become single, coarse and distant, and ventral truncation more pronounced, as in *Dufrenoyia*. Suture-line (see Pl. XVII. fig. 1) with comparatively slender saddles.

Measurements.—

Holotype (M.P.G. no. 2300)	110	·45	·28	·20
B.M. no. C 568 *a*	320	·36	·19	·33

Remarks.—The apparent smoothness of the body-chamber of the fragment figured in Pl. XVII. fig. 1 suggests a transition to *D. kiliani*, described below, and there are other passage-forms (*e. g.*, B.M. no. C 24716) to the latter (smaller) species, with smoother whorl-sides and a more rounded venter. A Lympne specimen (M.P.G. no. 30921) seems to differ from the typical examples of the present form merely in a slightly smaller whorl-thickness, and thus a narrower periphery, but unfortunately its outer whorl (still septate at 100 mm. diameter) is poorly preserved.

Large examples (*e.g.*, B.M. nos. C 568 *b*, C 3645), apparently from high beds (Upper Aptian), that seem to be referable to the present species differ chiefly in the earlier appearance of the coarse ribbing characteristic of the body-chamber, but there are also slight variations in whorl-section and thickness, and if a narrow interpretation were attempted every individual could be made the type of a new species.

The present form resembles the earlier *D. weissi* (Neumayr and Uhlig), and may account for part of the confusion prevailing with regard to the range of this much misunderstood species. *D. grandis* is certainly closer to *D. weissi* than are the large uncoiling forms of the *consobrinus*-type figured by Kilian and Reboul * and quoted by Roch †.

A Bedoule example in the British Museum (no. C 5840), perhaps a large specimen of the form represented in Kilian and Reboul's pl. vii. fig. 2, seems indistinguishable from comparable Atherfield examples (*e.g.*, L.F.S. no. 902, from "top. iv."), but the fragmentary Neufville examples of

* In Kilian, "Contribution à l'Etude des Faunes Paléocrétacées du S.E. de la France.—I. Fauna de l'Aptien inférieur des environs de Montélimar." Mém. Expl. Carte Géol. Dét. France, 1915, pl. iii. fig. 3, pl. iv. fig. 4 (=pl. ix. fig. 1).

† Loc. cit. (1927) p. 17.

Deshayesites recorded by Dr. Dutertre* can only be provisionally referred to the present species.

Horizon and Locality.—Lower Aptian, upper *deshayesi*-zone, and Upper Aptian, lower *martini*-zone (beds IV. and V.), Atherfield, Hythe, Lympne, Maidstone. Fragments of large *Deshayesites* from Sevenoaks (B.M. no. C 2526) and Hunstanton (C 29616) cannot be definitely assigned to this species, but a small example (B.M. no. C 29617) from the latter locality, although not typical, represents a closely related form.

5. *Deshayesites kiliani*, sp. n. (Pl. XV. fig. 1.)

Type.—An example (no. 30922) from Atherfield, Isle of Wight (probably the Lower Lobster Bed), in the Geological Survey Collection.

Diagnosis.—Coiling platy-, subleptogyral, subangustumbilicate; whorl-sides flattened, with rounded umbilical edge and narrowly arched venter. Sigmoidal ribs, as in *D. deshayesi*, in young; later the costation becomes indistinct on lateral area; blunt bulges at umbilical end, corresponding to about three secondaries each, continuous across venter, with forward sinus. Suture-line simple, as in *D. deshayesi.*

Measurements.—

Holotype (M.P.G. no. 30922)	68	·58	·27	·22
Paratype (L.F.S. no. 836)	66	·50	·30	·24

Remarks.—The holotype shows nearly half a whorl of body-chamber and the paratype also is not septate to the end, so that this species does not represent the inner whorls of one of the larger forms of *Deshayesites* of higher beds. A third example (M.P.G. no. 38047), which shows part of an almost smooth body-chamber, connects the more typical forms with a slightly more inflated variety (*e.g.*, M.P.G. no. 30911) that forms a transition to the species described below as *D. topleyi*, sp. n.

The young *D. kiliani* is similar to the immature *D. deshayesi*, but less sharply ribbed; it is also less evolute at all diameters, and the narrow body-chamber of the adult *D. deshayesi* is particularly characteristic, whilst the present form shows increasing flattening of the whorls. The transitions to the more finely ribbed *D. grandis* have already been referred to.

Horizon and Localities.—Lower Aptian, middle *deshayesi*-zone (beds II *b* and III *a*), Atherfield, Isle of Wight.

* "Crétacé Inférieur du Bas-Boulonnais etc.," Ann. Soc. Géol. Nord, vol. xlix. (1924) 1925, p. 242 (four specimens in the Musée Géologique at Boulogne).

6. *Deshayesites topleyi*, sp. n. (Pl. XV. fig. 5.)

1889. *Ammonites leopoldinus*, d'Orbigny; Bristow, &c., Geology Isle of Wight, 2nd ed. p. 266.

Type.—An example (L.F.S. no. 834) from the Lower Lobster Bed (=II *b*) of Atherfield, Isle of Wight.

Diagnosis.—Coiling subplaty-, substenogyral, subangustumbilicate. Whorl-sides slightly flattened, with high but rounded umbilical slope and arched venter. Ribs sigmoidal, blunt and indistinct, slightly bulging at umbilical end, and traversing venter with a slight forward sinus. About three secondaries to each primary, but division not distinct. Suture-line as in *D. deshayesi.*

Measurements.—

Holotype (L.F.S. no. 834)	55	·47	·34	·24
Paratype (L.F.S. no. 835)	65	·46	·32	·23

Remarks.—This species differs from the last, and especially from *P. deshayesi*, in its inflated whorl-shape and blunt and indistinct ribbing. In the holotype (Pl. XV. fig. 5) the ribbing is still visible, though faint; in the (unfigured) paratype it has almost disappeared, and it is probably on account of this smoothness, combined with a rounded venter and elliptical whorl-section, that this species has been mistaken by Fitton and some of his followers for d'Orbigny's *Amm. leopoldinus* (in coll.).

There is an undescribed form (L.F.S. nos. 919–920), characteristic of bed III *a*, but beginning already in II *b*, with blunt but extremely coarse ribs at all diameters, which in its shape is intermediate between the present species and *D. consobrinoides*. Another new form, discussed above under *D. latilobatus*, on account of a similar tendency to smoothness, also resembles *D. topleyi*, but is much more finely ribbed.

Horizon and Locality.—Lower Aptian, middle *deshayesi*-zone (II *b* and III *a*), Atherfield, Sandown (?), Isle of Wight.

7. *Deshayesites vectensis*, sp. n. (Pl. XVI. figs. 5 *a*, *b*.)

Type.—An example (B.M. no. C 889 *c*) from Blackgang, Isle of Wight (J. S. Gardner Coll.).

Diagnosis.—Coiling subplaty-, subleptogyral, subangustumbilicate. Whorl-sides gently rounded, venter first flattened, later arched. Ribbing first bifurcating and gently sigmoidal, as in *D. deshayesi*; later with intercalated, short secondary costæ. Suture-line probably simple, as in *D. punfieldensis.*

Measurements.—

Holotype (Pl. XVI. fig. 5 *a*)	39	·37	(?)	·34
Paratype (Pl. XVI. fig. 5 *b*)	70	·44	·31	·26

Remarks.—This species is close to *D. consobrinoides*, with equally coarse ribbing, but the shorter secondaries and the sharp and thin longer costæ of *D. vectensis* enable us to distinguish the two species. The present form is also connected by transitions with *D. punfieldensis*, showing still coarser costation and a more pronounced tendency of the periphery to become angular.

The extremely coarsely ribbed new form, referred to above under *D. topleyi*, has inner whorls somewhat resembling the present form, but it not only comes from a lower bed and grows to large dimensions (*e.g.*, B.M. no. C 2687), but it has much blunter ribs. On the other hand, in the case of such inner whorls of possibly this new species as those here figured (Pl. XVII. fig. 5), the ribbing is very similar to that of *D. vectensis*, and only the more distinct truncation of the periphery in the latter species (in addition, perhaps, to its wider lateral lobe) may serve as a distinguishing feature. A Punfield specimen in the British Museum (no. C 4979), unfortunately poorly preserved, is apparently identical with the small *Deshayesites*, sp. n., here figured, and shows by its high umbilical edge and loose coiling that the undescribed form here discussed is closer to *D. consobrinoides* than it is to the present species.

Horizon and Locality.—Aptian, upper *deshayesi*- or lower *martini*-zone (iv. or v.?), Blackgang, Isle of Wight.

8. *Deshayesites punfieldensis*, sp. n. (Pl. XVI. fig. 3.)

1871. ? *Ammonites deshayesi*, Leymerie; Judd, "Punfield Formation," Quart. Journ. Geol. Soc. vol. xxvii. p. 215.

Type.—The Atherfield example (M.P.G. no. 30915) figured in Pl. XVI. figs. 3 *a*, *b*.

Diagnosis.—Like last, but with coarser ribs and more angular periphery. Suture-line (see Pl. XVI. fig. 3) very simple.

Measurements.—

Holotype (Pl. XVI. fig. 3)	51	·40	·31	·36
B.M. no. C 889 *a* (transition to *D. vectensis*).	48	·38	·30	·32

Remarks.—This species in the truncation of its periphery is somewhat transitional to *Dufrenoyia*, but it is connected by various transitions with *D. vectensis*, discussed above. The rather poorly preserved example listed in the table of measurements as one of these transitions shows a rounded

ventral area on the last half-whorl, and apparently was collected together with the two more finely ribbed *D. vectensis* here figured.

The inner whorls of the very coarsely costate new form, above referred to, are similar to the present species, but less loosely coiled and without ventro-lateral edges. The latter cause resemblance to *Dufrenoyia furcata* (Sowerby), but this is still more angular and more coarsely ribbed.

Horizon and Locality.—Lower Aptian, upper *deshayesi*-zone (and lower *martini* ?). Punfield, Dorset; Atherfield and Blackgang, Isle of Wight.

9. *Deshayesites consobrinus* (d'Orbigny).

1841. *Ammonites consobrinus*, d'Orbigny, Pal. Française, Terr. Crét. Céphal. p. 147, pl. xlvii.
? 1889. *Ammonites consobrinus*, d'Orbigny; Bristow, &c., Geology, Isle of Wight, 2nd ed. p. 266.
1913. *Parahoplites consobrinus* (d'Orbigny); Kilian, *loc. cit.* (Lethæa) p. 344.
1915. *Parahoplites consobrinus*, Kilian & Reboul, *loc. cit.* (Aptien Inférieur) p. 41 [Pl. XVII. fig. 6 ?].
1927. *Parahoplites consobrinus*, Roch, *op. cit.* (Mém. Soc. Géol. France) n. s. vol. iv. p. 15.

This oft-quoted form is before me in a typical Bedoule example (B.M. no. C 5841) of 300 mm. diameter, and I would identify with this species also an Atherfield specimen (B.M. no. C 993), to judge by its sandy matrix from the Crackers (bed III *a*). It is still septate at nearly 150 mm. diameter, has dimensions ·37, ·23, ·33, and it well shows the simple suture-line, with its very short external lobe. Since d'Orbigny's drawing is somewhat diagrammatic, the suture-line of the Atherfield specimen is here reproduced (text-fig. *a*, p. 438).

A Hythe example (M.P.G. no. 30919), of dimensions 125, ·40, ·25, ·28, differs in its smaller umbilicus, and thus may be designated var. *involuta*. Its inner whorls, with neatly truncate periphery, resemble those of *D. grandis*; but the outer whorl, in ribbing, is indistinguishable from that of *D. consobrinus*.

Horizon and Locality.—Lower Aptian, middle and upper *deshayesi*-zone. Atherfield, Isle of Wight, and Hythe, Kent.

10. *Deshayesites fissicostatus* (Phillips).

1829. *Ammonites fissicostatus*, Phillips, Geology of Yorkshire, i. p. 123, pl. ii. fig. 49.
1902. *Hoplitides bodei*, var. *tenuicostata*, v. Koenen, *loc. cit.* (Ammoniten d. Nordd. Neocom.) p. 221, pl. ix. figs. 2 *a–c*.

1924. *Parahoplitoides fissicostatus* (Phillips); Spath, *loc. cit.* (Speeton Clay) p. 79.

This species, as represented by typical Speeton examples in the Bean and Lamplugh Collections (B.M. no. C 24718 and C 32332), may unhesitatingly be identified with the variety *tenuicostata* of "*Hoplitides bodei*" of v. Koenen which is before me in a perfect Timmern (Brunswick) specimen (B.M. no. C 14367). Phillips's original figure being very poor, this species has been misinterpreted by most authors. It is what Yorkshire geologists have generally recorded as *Amm. deshayesi*, and it probably includes *D. dechyi* (Papp), Renngarten *.

Horizon and Localities.—Lower Aptian, lower *deshayesi*-zone. Speeton, Yorkshire (upper part of bed B); Hunstanton, Norfolk (base of "Carstone"); Wicken, Cambs.

11. *Deshayesites bodei* (v. Koenen).

1902. *Hoplitides bodei*, v. Koenen, Ammonitiden des Norddeutschen Neocom. p. 221, pl. ix. figs. 1 *a–c* only.
1924. *Parahoplitoides bodei* (v. Koenen); Spath, pp. 78–9.

As restricted to v. Koenen's first example (*i. e.*, the coarsely ribbed forms), this species occurs together with the more abundant *D. fissicostatus* in Upper B at Speeton, as well as at the base of the Carstone of Hunstanton, but generally only in body-chamber fragments.

Horizon and Locality.—Lower Aptian, (lower ?) *deshayesi*-zone, Speeton, Yorkshire (upper part of bed B); Hunstanton, Norfolk (base of "Carstone," B.M. no. C 26634, C 32333).

12. *Deshayesites* sp. n. ind.

1924. *Parahoplitoides tenuicostatus* (v. Koenen); Spath, Speeton Clay, p. 79.

This is a closely ribbed form of the group of *D. fissicostatus*, and was formerly included in v. Koenen's variety, because they occur together also at Timmern (Brunswick) and are connected by numerous transitions. Since the figured example of the var. *tenuicostata* of v. Koenen's *D. bodei*, however, is identical with the true *D. fissicostatus*, it may seem advisable to separate the still considerably more closely costate forms with a new name. They occur plentifully, though mostly in fragments, in the "Carstone" of Hunstanton, associated with passage-forms to *D. fissicostatus* on

* *Loc. cit.* (Mém. Com. Géol. n. s. livr. cxlvii. 1926), p. 100, pl. ii. figs. 11, 12.

the one hand, and to the forms of the *læviusculus* group discussed below on the other.

Horizon and Locality.—Lower Aptian, lower *deshayesi*-zone, Speeton, Yorkshire (upper part of bed B); Hunstanton, Norfolk (base of "Carstone"); Wicken, Cambs.

13. *Deshayesites* aff. *læviusculus* (v. Koenen).

1901. *Hoplitides læviusculus*, v. Koenen, *loc. cit.* (Ammonitiden d. Norddeutschen Neocom.) p. 224, pl. viii. figs. 4 *a*, *b*, 5 *a–c*.
?1926. *Parahoplitoides læviusculus* (v. Koenen); Whitehouse, Cret. Ammonoidea, E. Australia, Mem. Queensland Mus. vol. viii. pt. 3, p. 206.

It is not certain at present whether either the Woodhatch forms previously * recorded as *P.* spp. n. cf. *læviusculus* or the Carstone form listed under that name from Hunstanton† belong to v. Koenen's species. The former has fine sigmoidal striation, and shows more resemblance to the inner whorls of that author's larger figure, but it seems to remain small (*e.g.*, B.M. no. C 29531). The Hunstanton type (B.M. no. C 32330 G. W. Lamplugh Coll., no. C 29614 H. le Strange Coll.), on the other hand, may be closer to v. Koenen's smaller specimen, and has the same suture-line, but it is less distinctly ribbed. As no German examples are at present available for comparison, and pending the publication of figures of the British forms of the *fissicostatus-bodei-læviusculus* group, the provisional identification must suffice.

Dr. Kitchin ‡ recorded *D. læviusculus* from the Dover Boring, associated with *D. deshayesi*. In the Isle of Wight comparable examples of the latter species have not been found below the Lower Lobster Bed (II *b*), so that the British forms here provisionally referred to *D. læviusculus* seem to occur at a higher horizon than the German types.

Horizon and Localities.—Lower Aptian, lower and middle *deshayesi*-zone, Hunstanton, Norfolk (base of "Carstone"); Wicken, Cambs; Woodhatch, near Reigate, Surrey; and Dover Boring, Kent ("Atherfield Clay").

* G. W. Butler, "*Perna* Bed and Weald Clay at Reigate," Proc. Geol. Assoc. vol. xxxiii. 1922, p. 316. Spath, 'Monograph Ammonoidea of the Gault,' Pal. Soc. vol. for 1921 (1923), p. 66.

† Spath, "Ammonites of the Speeton Clay and the Subdivisions of the Neocomian," Geol. Mag. vol. lxi. 1924, p. 79.

‡ In Lamplugh and Kitchin, "Mesozoic Rocks in some of the Coal Explorations in Kent," Mem. Geol. Survey, 1911, p. 107.

Genus Dufrenoyia (Burckhardt MS.), Kilian *, 1915.

1. *Dufrenoyia furcata* (J. de C. Sowerby).

1836. *Ammonites furcatus*, J. de C. Sowerby, in Fitton, "Strata below the Chalk," Trans. Geol. Soc. (2) vol. iv. p. 339, pl. xiv. fig. 17.
1875. *Ammonites furcatus*, J. de C. Sowerby; Topley, Geology of the Weald, p. 421.
1913. *Hoplites furcatus* (Sowerby); Kilian, *loc. cit.* (Lethæa) p. 348 (pars).
1915. *Dufrenoyia furcata* (Sowerby); Kilian and Reboul, *loc. cit.*, Faune de l'Aptien infér. des Environs de Montélimar, pp. 37, 205.
1923. *Dufrenoyia furcata* (Sowerby); Spath, *loc. cit.* (Summary of Progress) p. 146.
1925. *Stenhoplites furcatus* (Sowerby); Spath, in Walton, Folkestone, p. 31.
1925. *Dufrenoya furcata* (Sowerby); Burckhardt, "Aptiano de Nazas," Bol. Inst. Geol. Mexico, no. 45, p. 17.
1927. *Parahoplites* (*Dufrenoya*) *furcatus*, J. Sow. (in Fitton); Roch, *loc. cit.*, Mém. Soc. Géol. France, n. s. vol. iv. p. 19.

This well-characterized species is not identical with *D. dufrenoyi* (d'Orbigny) †, as Kilian held. On account of its rarity it is probably represented in only few collections, and therefore often misinterpreted. The holotype (M.P.G. no. 2290, ex Geol. Soc. Coll.) is merely a body-chamber cast, with the impression of the inner whorls preserved in the matrix. A similar fragment (B.M. no. C 2532) from "East of Ladder Chine" has a slightly wider whorl-side, and is thus transitional to *D. truncata*, described below.

A coarsely ribbed variety (M.P.G. no. 25503) has only six long and distant costæ, with two short intermediaries, on nearly half a whorl of body-chamber. A smaller fragment of probably the same variety has also been found at the base of the "Carstone" of Hunstanton (Mr. Lamplugh's collection in the British Museum, no. C 32331).

Roch, who, like Kilian, united *D. furcata* and *D. dufrenoyi*, stated that this typically Gargasian (*i. e.*, Upper Aptian) species occurred already in the Upper Bedoulian, associated with *Deshayesites consobrinus*. The British forms are also probably all of Upper Eo-Aptian age, and Kilian's ‡ "*furcatus*-zone" I have on a previous occasion § been obliged to reject.

Horizon and Localities.—Lower Aptian, upper *deshayesi*-zone, Hythe, Kent (Hythe Beds); Isle of Wight ("East of

* Burckhardt, in 1925, adopted the spelling "*Dufrenoya.*"
† Pal. Française, Ter. Crét. (1841) p. 200, pl. xxxiii. figs. 4–6.
‡ *Loc. cit.* (Lethæa, 2, 1910) p. 287 (table).
§ *Loc. cit.* (Summary of Progress, 1922) 1923, p. 147.

Ladder," by the matrix not lower than bed IV); Hunstanton, Norfolk (base of "Carstone"). The record of this species from the *Perna*-bed (in Fitton*) must be questioned.

2. *Dufrenoyia lurensis* (Kilian). (Pl. XV. fig. 4.)

1888. *Hoplites lurensis*, Kilian, "Sur quelques Fossiles du Crét. Infér. de la Provence," Bull. Soc. Géol. France, [3] vol. xvi. p. 681, pl. xx. figs. 2 *a*, *b*.
1913. *Hoplites lurensis*, Kilian, *loc. cit.* (Lethæa) p. 348, pl. viii. figs. 8 *a*, *b* (pl. x. fig. 5 ?).
1925. *Dufrenoya lurensis* (Kilian); Burckhardt, *loc. cit.* (Bol. Inst. Geol. Mexico, no. 45) p. 17.

The unique British example here figured shows half a whorl of body-chamber, and on the septate earlier half the suture-line is well displayed. It differs from that of *D. dufrenoyi* † only in minor details. *D. furcata* (Sowerby) has a less coarsely ribbed body-chamber.

Horizon and Locality.—Lower Aptian, upper *deshayesi*-zone (Hythe Beds), Hythe (Manchester Mus. no. L 11607, ex Dixon Coll.).

3. *Dufrenoyia truncata*, sp. n. (Pl. XVI. figs. 4 *a*, *b*, *c*.)

Type.—The Hythe example (Manchester Museum, no. L 11606), figured in Pl. XVI. fig. 4 *b*.

Diagnosis.—Coiling subplaty-, subleptogyral, subangustumbilicate. Whorl-sides flattened, with gentle umbilical slope; venter truncate. Alternate long and short ribs, flattened on outer half and ending at ventral edge with a slight clavus, but symmetrically connected across periphery (in adult only) with ribs of opposite side. In the young the venter is first arched, with sigmoidal ribs of the sides almost meeting; then smooth siphonal band becomes wider, and the edges of smooth venter are fully developed at about 15 mm. diameter. Suture-line probably similar to that of *D. furcata*.

Measurements.—

Holotype (Pl. XVI. fig. 4 *b*)	36	·47	·30	·27
B. M. no. 62154	65	·43	·29	·27

Remarks.—This form, like the less compressed *D. furcata*, generally occurs as casts of body-chambers, but the small specimen figured in Pl. XVI. fig. 4 *a* is probably complete.

* *Loc. cit.* (Quart. Journ. Geol. Soc. vol. iii. 1847) p. 293.

† Figured in Sarasin, "Quelq. consid. sur les genres *Hoplites*, *Sonne*-[illegible] Bull. Soc. Géol. France [3], vol. xxv. p. 768, pl. ii. fig. 6 [illegible]

It shows the simple suture-line and over half a whorl of body-chamber, with the plain mouth-border (on the side not figured). The larger fragment listed as no. 2 in the above table of measurements is almost identical with the body-chamber figured in Pl. XVI. fig. 4 *c* (M.P.G. no. 30920), and the peripheral view might have been taken from either.

D. dufrenoyi (d'Orbigny), according to specimens in the British Museum, differs from the present species in having the typically flattened and transversely ribbed venter already at a stage when *D. truncata* still resembles *Deshayesites*; but the two species are sufficiently close to make it unnecessary to adopt a separate generic name ("*Stenhoplites*," Spath, 1922 *) for the *furcatus* group.

A new Colombian species (B.M. no. 46561 *a*), which I had previously considered to belong to the group of the more evolute *Hemihoplites feraudianus*, d'Orbigny sp. †, does not differ greatly from the form here described, and may well represent a passage-form. The "*Dufrenoya*" *stuebeli* (Gerhardt), figured by Burckhardt ‡, is also similar, but Mayer-Eymar's § *Hoplites somalicus*, also transitional from *Hemihoplites* to *Dufrenoyia* and *Deshayesites* is more evolute.

Horizon and Locality.—Lower Aptian, upper *deshayesi*-zone (Hythe Beds), Hythe, Kent.

Genus Parahoplites, Anthula, 1899, emend.

1. *Parahoplites nutfieldiensis* (J. Sowerby).
(Text-fig. *b*, p. 438.)

1815. *Ammonites nutfieldiensis*, J. Sowerby, Min. Conchology, vol. ii. p. 11, pl. cviii.

1845. *Ammonites nutfieldiensis*, J. Sowerby; Forbes, *loc. cit.* (Quart. Journ. Geol. Soc. vol. i.) p. 353.

1869. *Ammonites nutfieldiensis*, J. Sowerby; Meyer, "Lower Greensand of Godalming," Geol. Assoc. p. 16.

1875. *Ammonites nutfieldiensis*, J. Sowerby; Topley, "Geology of the Weald," Mem. Geol. Survey, p. 421.

1921. *Parahoplites nutfieldiensis* (J. Sowerby); Spath, in L. Dudley Stamp, "Excursion to Tilburstow Hill, &c.," Proc. Geol. Assoc. vol. xxxii. p. 31.

1925. *Parahoplites nutfieldiensis*, J. Sowerby; Spath, *loc. cit.* (Summary of Progress) p. 146.

Sowerby's figure of this species, while not obviously wrong, was not drawn with his customary accuracy. The holotype

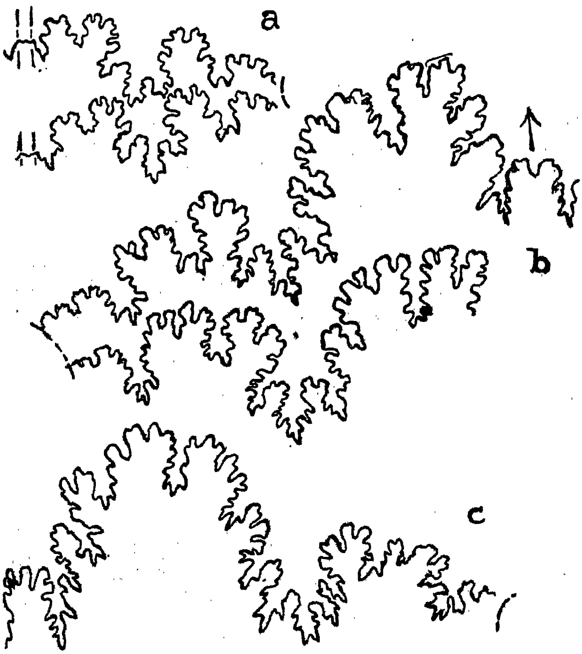
* See Spath, *loc. cit.* (Summary of Progress for 1922) 1923, pp. 146, 147 (footnote). *D. furcata* there should have been described as of "pre-*dufrenoyi*" age, not "pre-*deshayesi*" age.

† *Loc. cit.* (Pal. Française) 1841, p. 324, pl. xcvi. figs. 4–5.

‡ *Loc. cit.* (Bol. Inst. Geol. Mexico, no. 45, 1925) p. 18, pl. x. figs. 5–6.

§ "Neocom-Versteinerungen a. d. Somali Land," Vierteljahrschr. Naturf. Ges. Zürich, vol. xxxviii. 1893, p. 11, pl. ii. figs. 5–6.

(B.M. no. 43882) had been recognized already by Crick * as differing so considerably from the figure that he added "If the figured specimen, figure has been much restored." There is no dearth, however, of fairly well-preserved examples of this species, and it is hoped that an illustration of one of the large specimens known from Nutfield and the Bargate Stone of Surrey, or from Seend in Wiltshire, may



External suture-lines (natural size) of (a) *Deshayesites consobrinus* (d'Orbigny). Lower Aptian, Atherfield, Isle of Wight (B.M. no. C 993); (b) *Parahoplites nutfieldiensis* (J. Sowerby), from the Upper Aptian of Seend, Wilts (M.P.G. no. 30070); (c) *Parahoplites*, sp. n., same locality (B.M. no. 88723).

soon be given. Meanwhile, the last two suture-lines of a specimen from the last locality (with nearly half a whorl of body-chamber and proportions: 150, ·50, ·42, ·25) are here figured (text-fig. *b*).

The form is close to *P. maximus*, Sinzow †, which at a diameter of 180 mm. has costation resembling that of the

* 'List of Types and Figured Specimens of Fossil Cephalopoda in the British Museum,' 1898, p. 22.

† *Loc. cit.* ('Ammonitiden Unt. Gault Mangyschlaks') 1907, p. 464, pl. i. figs. 1–3.

immature *P. nutfieldiensis.* In the adult, or even while still entirely septate (at diameters of 100—300 mm.), the latter species acquires more closely-set primaries, as well as secondaries, and the whorl-section is more rounded and the periphery wider at all stages.

Horizon and Localities.—Upper Aptian, *subnodosocostatum*-zone, Nutfield, Surrey; Godalming and neighbourhood (Bargate Stone); Pulborough, Sussex; Seend, Wilts. A Hythe specimen in the Manchester Museum (no. L. 12046, in Dixon Coll.) is preserved in a bright green glauconitic sandstone.

2. *Parahoplites* aff. *campichei* (Pictet & Renevier), Sinzow.

1907. *Parahoplites campichei* (Pictet & Renevier); Sinzow, Untersuchung Ammonitiden Mangyschlaks, &c., *loc. cit.* p. 460, pl. i. fig. 4.

Associated with typical *P. nutfieldiensis* and allied forms at Seend, Wiltshire, there occur specimens (*e.g.*, B.M. no. 88723 *b*) that are more closely comparable to the large Russian form figured by Sinzow than to Pictet and Renevier's * diagrammatic figure. The inner whorls, however, are not quite so compressed, differing, in fact, little from those of *P. nutfieldiensis.* There are some British examples that in their finer costation and narrower umbilicus may be compared to the smaller specimen figured by Sinzow (*loc. cit.* pl. i. fig. 6), but their greater general resemblance to *P. nutfieldiensis* makes it probable that they represent merely a more densicostate form of the same group, which also includes *P. uhligi*, Anthula †. The suture-line of one example (B.M. no. 88723) of this unnamed form is represented in text-fig. *c*.

A larger example (M.P.G. no. 30971) of probably the same form as the first is still septate at 140 mm. diameter, but slightly crushed on one side, which shows a peculiarly flexiradiate costation. This specimen also shows close agreement with Sinzow's larger figure (Pl. XIV. fig. 4), as does a Compton (Bargate Stone) example of over 200 mm. diameter (B.M. no. C 25728).

A new form of the same group, to be figured later, is from the green rock at Hythe that also yielded the *P. nutfieldiensis*, recorded above (Manchester Museum, no. L 12047).

Horizon and Localities.—Upper Aptian, *subnodosocostatum*-zone, Nutfield, Surrey, and Seend, Wiltshire.

* "Aptien de la Perte du Rhône, etc.," Mat. Pal. Suisse, i. pl. ii. fig. 2.

† "Kreide des Kaukasus," Beitr. Pal. Österr.-Ungarns, vol. xii. 1899, p. 114, pl. x. fig. 1.

3. *Parahoplites simmsi* (Forbes), nov. (Pl. XIV. figs. 1 *a*, *b*.)

1845. *Ammonites nutfieldiensis*, Sowerby, var. *simsii* *, Forbes, *loc. cit.*, Quart. Journ. Geol. Soc. vol. i. p. 353.

1923. *Parahoplites* (*Acanthoplites*?) *simmsi* (Forbes), Spath, *loc. cit.* (Summary of Progress) p. 146.

1925. *Parahoplites* (*Acanthoplites*?) *simmsi* (Forbes), Spath, "Notes on Ammonites, &c.," in Walton, 'Folkestone,' p. 31.

The holotype, not previously figured, has dimensions:—86, ·41, ·41, ·35. Forbes's original description of this variety (correctly believed to be "perhaps a distinct species") was as follows:—"Inner volutions more exposed, outer whorl narrower [than in *Amm. nutfieldiensis*], ribs strong and acute." In view of the poor state of preservation of the holotype little can be added to this description, and no additional examples of this species appear to have been found. The matrix is identical with that of *Parahoplites nutfieldiensis* and allies from Seend in Wiltshire. Sowerby recorded a specimen of *Amm. nutfieldiensis* from Hythe, preserved in a different matrix, namely "Greensand," which may be the example in the Dixon Collection referred to above; but I have not seen any ammonites from the "brown ferruginous sandstone, with nodules, at the base of the Folkestone Sands," referred to on previous occasions.

This species was formerly stated to resemble *Acanthoplites ashiltaensis*, Anthula †, but there is no evidence that the inner whorls were tuberculate, and there are a number of comparable *Parahoplites* that develop a similar outer whorl, also *Colombiceras* of the type of *C. karsteni* (Marcou ‡), although in the latter the costæ are peculiarly flattened. The only British example known to me that could be attached to the genus *Colombiceras* (of the *crassicostatum*-group) is the fragmentary ammonite figured by Keeping § as "*Ammonites cornuelianus*." Forms of the *crassicostatum* and *gargasense* type, according to Kilian ‖, characterize the lower zone of the Upper Aptian, and "*Acanthoplites*" *tobleri* (Jacob) ¶ the uppermost zone. The last species also shows superficial resemblance to *P. simmsi*, but it is distinctly

* Named after Mr. W. F. Simms, F.G.S. (see Quart. Journ. Geol. Soc. vol. i. 1845, p. 76).

† "Kreide des Kaukasus," Beitr. Pal. Österr.-Ungarns. vol. xii. 1899, p. 117, pl. x. figs. 2–4.

‡ See Karsten, 'Géologie de l'ancienne Colombie, &c.,' 1886, pl. v. fig. 1.

§ *Loc. cit.* (1883) p. 89, pl. i. figs. 9 *a*–*c*.

‖ *Loc. cit.* (Lethæa, iii. 1913) p. 350.

¶ *Loc. cit.* (Mém. Soc. Pal. Suisse, vol. xxxiii. 1906, p. 11, pl. ii.

transitional between the *Parahoplites* and *Colombiceras* of the *nutfieldiensis* subzone and the Lower Albian forms that become abundant in post-*ashiltaensis* (or *tobleri*) times, or what I called the Acanthoplitan age.

Horizon and Locality.—Upper Aptian, *subnodosocostatum*-zone, Kent coast ("Hythe").

4. *Parahoplites sussexensis*, sp. n. (Pl. XVI. fig. 1.)

Type.—The Pulborough example (M.P.G. no. 46131) figured in Pl. XVI. fig. 1.

Diagnosis.—Coiling subplaty-pachygyral; subangustumbilicate. Whorl-section greatly depressed, transversely oval, with the ventral area not definitely separated off from the rounded sides. Ribbing sharp, irregularly long and short, and slightly sigmoidal, continuous across the periphery with a forward sinus. Suture-line unknown.

Measurements.—

Holotype (M. P. G. 46131)	50	·42	·54	·28.

Remarks.—This species belongs to the same group as the form here described as *P.* cf. *multicostatus* (Sinzow), and it is possible that the young example figured in Pl. XVI. fig. 2 may turn out to represent its immature stage, in spite of its apparently less sharp type of ribbing. The externally similar forms described by Zinzow seem to have not only different ribbing but a different whorl-shape, so that a new specific name may be suggested for the Pulborough form, in spite of the fact that its inner whorls and suture-line are as yet unknown.

P. melchioris, Anthula *, differs chiefly in its less acute ribbing, which is also more regular.

It would appear that forms of this type are not confined to the uppermost Aptian, but still occur in the lowest Albian.

Horizon and Locality.—Upper Aptian, *subnodosocostatum*-zone, Pulborough, Sussex (Sandgate Beds ?) †.

5. *Parahoplites* cf. *multicostatus*, Sinzow.

1907. *Parahoplites multicostatus*, Sinzow, "Ammonitiden aus dem Unt. Gault Mangyschlaks, &c.," *loc. cit.* p. 459, pl. ii. figs. 5–11.

This variable species is a close ally of the genotype of *Parahoplites*, namely, *P. melchioris*, Anthula, but the only

* *Loc. cit.* (1899) p. 112, pl. viii. figs. 4–5.

† See Elsden, "Excursion to Pulborough," Proc. Geol. Assoc. vol. xvii. 1901, p. 185.

English examples known are not well enough preserved for definite identification. The most typical specimen (B.M. no. 10783), a crushed body-chamber fragment comparable to Sinzow's fig. 6 but slightly larger, is unfortunately not localized. More doubtful fragments are from Shanklin (B.M. no. C 2533) and Sevenoaks (B.M. nos. C 8280 *a, b*); the latter differ from the immature form here figured (Pl. XVI. fig. 2) in a more pronounced peripheral sinus. A Harsum (Hanover) example of *P. schmidti*, Jacob *, in the British Museum (No. C 14359) differs chiefly in its more distant costation.

Horizon and Locality.—Upper Aptian, upper *subnodoso-costatum*-zone. Shanklin, Isle of Wight; Sevenoaks, Kent; Nutfield, Surrey (B. M. no. C 22640).

6. *Parahoplites* sp. juv. (Pl. XVI. fig. 2.)

The small example here figured has dimensions 25, ·40, ·52, ·25, and thus differs but little from the inner whorls of Sinzow's *Parahoplites multicostatus*, pars (Pl. XV. figs. 7, 8), but its ribbing is different from that of the young *P. multicostatus* figured by Sinzow in his pl. ii. fig. 11. In the English form, at 10 mm. diameter already, there are prominent flexicostæ with a distinct peripheral sinus forward; also on the earlier half of the outer whorl two intercalated ribs between a pair of long costæ are of more frequent occurrence than merely one intermediary.

Horizon and Locality.—Upper Aptian, upper *subnodoso-costatum*-zone. Isle of Wight (Sandrock Series ?).

Family II. Cheloniceratidæ, Spath, 1923.

Genus Procheloniceras, Spath, 1923.

1. *Procheloniceras* cf. *albrechti-austriæ* (Hoheuegger MS.), Uhlig.

1882. *Acanthoceras albrechti-austriæ* (Hohenegger in coll.), Uhlig, *loc. cit.* (Wernsdorfer Schichten) p. 253, pl. xx. fig. 18, pl. xxii., pl. xxiii. fig. 1.
1915. *Douvilleiceras albrechti-austriæ* (Hohenegger), Uhlig sp., Kilian & Reboul, *loc. cit.* (Aptien inférieur Montélimar) p. 57, pl. i. fig. 16, pl. iii. fig. 5, pl. viii. fig. 3.
1924. *Cheloniceras albrechti-austriæ* (Hohenegger), Spath, *loc. cit.* (Speeton Clay) p. 79.

What I would consider one of the most typical fragments of this species was collected loose at Atherfield (L.F.S. no. 523), but its gritty matrix is not characteristic of any

[illegible] (Mém. Soc. Pal. Suisse, vol. xxxiii.) 1906, p. 12, pl. ii. [illegible]

one bed, although it agrees with that of specimens from "top IV" and of a *Cheloniceras* cf. *cornuelianum* from V or VI. In view of the similarity of fragments of this species to forms like "*Ammonitoceras*" cf. *transcaspium* (Sinzow), discussed below, and to outer whorls of *Cheloniceras* of the *cornuelianum* group, records of this form are perhaps not reliable, especially since the species has been differently interpreted by authors like Kilian *, Sinzow †, and Roch ‡.

The fragment from the Atherfield Clay in the Dover Boring, discussed by Dr. Kitchin §, may be referable to the present form, but it also cannot be definitely identified. It was compared to a large example figured by v. Koenen ||, but this was included by Kilian and Reboul ¶ in their "*Douvilleiceras pachystephanum*" (Uhlig).

Horizon and Localities.—Lower Aptian, *deshayesi*-zone, Atherfield, Isle of Wight; Dover Boring ("Atherfield Clay"), and (?) Hunstanton, Norfolk (base of "Carstone").

2. *Procheloniceras* cf. *pachystephanus* (Uhlig).

1882. *Acanthoceras pachystephanus*, Uhlig, "Cephalopoden-Fauna der Wernsdorfer Schichten," Denkschr. Akad. Wiss. Wien, Math. Naturw. Cl. vol. xlvi. p. 255, pl. xxiv. figs. 1–2.

1913. *Douvilleiceras pachystephanus* (Uhlig), Kilian, *loc. cit.* (Lethæa) p. 340.

*1915. *Douvilleiceras pachystephanus* (Uhlig), Kilian & Reboul, *loc. cit.* (Aptien Inférieur Montélimar) p. 61, pl. iii. fig. 4, pl. iv. fig. 7, pl. viii. fig. 4.

A small body-chamber portion of an ammonite, resembling the final stage of Uhlig's uncompressed holotype, is provisionally referred to this species, but other forms of *Procheloniceras* might produce similar fragments. This example is listed separately only because it comes from the true Atherfield Clay, in the flat, red, ironstone-nodules of which ammonites seem to be extremely rare.

Horizon and Locality.—Lower Aptian, lower *deshayesi*-zone (II *a*). Atherfield, Isle of Wight.

3. *Procheloniceras* ? sp. ind. (Pl. XVII. fig. 4.)

The plaster cast of an umbilical impression here figured is interesting, because, apart from the large fragment of *P.* cf. *pachystephanus* (Uhlig) recorded above, it is the only

* *Loc. cit.* (Lethæa) 1913, p. 339, pl. viii. fig. 2.

† *Loc. cit.* (*Douvilleiceras*-Arten) 1906, p. 167, pl. iv. figs. 1, 2.

‡ *Loc. cit.* (Aptien Bedoule, 1927) p. 20, pl. ii.

§ In Lamplugh and Kitchin, "Mesozoic Rocks in some of the Coal Explorations in Kent," Mem. Geol. Survey, 1911, p. 108.

|| *Loc. cit.* (Ammonitiden Nordd. Neocom. 1902) pl. xli. fig. 1.

¶ *Loc. cit.* (1915) p. 61.

ammonite known to me from the true Atherfield Clay. The inner whorls seem to be merely costate, not tuberculate, so that the identification must remain uncertain, and comparable umbilical impressions of *Parahoplitoides* (e.g., L.F.S. no. 718, from "top IV.") are not strikingly different.

Horizon and Locality.—Lower Aptian, lower *deshayesi*-zone (II *a*). Atherfield, Isle of Wight.

Genus Cheloniceras, Hyatt, 1903.

1. *Cheloniceras hambrovi* (Forbes).

1845. *Ammonites hambrovi*, Forbes, *loc. cit.* (Quart. Journ. Geol. Soc. vol. i.) p. 354, pl. xiii. fig. 4.
1847. *Ammonites hambrovi*, Forbes; Fitton, *loc. cit.* (Quart. Journ. Geol. Soc. vol. iii.) p. 299.
1875. *Ammonites hambrovi*, Forbes; Topley, Geology of the Weald, p. 421.
1913. *Douvilleiceras hambrovi* (Forbes), Kilian, *loc. cit.* (Lethæa) p. 340.
1921. *Cheloniceras hambrovi* (Forbes), Spath, *loc. cit.* (Zululand) p. 317, pl. viii. fig. 3.

This species is represented by numerous examples, and it may safely be stated that there are no two specimens identical. In the young there is great resemblance to *Ch. royerianum* (d'Orbigny), but the principal ribs are coarser and the accompanying varices are not so regular as in d'Orbigny's drawing, whilst the intervening spaces are faintly or sometimes even distinctly ribbed in Forbes's species. One large example (M.P.G. no. 30947), at over 140 mm. diameter, has about thirteen coarse umbilical bulges, as against only about eight in the much smaller lectotype. The finest specimen of all, however, from the Saxby Collection (B.M. no. 46588), of nearly 200 mm. diameter, shows that on the body-chamber the ribs tend to become single, so that this specimen shows sixteen inner bullæ. No small specimens are known from beds higher than III, but there are some gigantic examples of *Cheloniceras* from the Isle of Wight (preserved in a reddish-brown ferruginous sandstone, which must be above the top of the Lower Aptian, that combine an inflated whorl-shape with single blunt costation. In spite of their resemblance to the adult *C. hambrovi*, these large forms probably represent fully grown *Cheloniceras* of the type of *C. crassum*, described below, but their inner whorls are not preserved.

A particularly coarse variety (var. *horrida*, nov.) has only five exaggerated bulges, overhanging the deep umbilicus at a diameter of 54 mm. The type of this var. *horrida* is apparently complete, with about half a whorl of

body-chamber, and its early *royerianum*-stage and the succeeding *perli*-stage are reduced to a minimum.

The adult suture-line figured by Forbes is fairly correct, although it looks somewhat unusual; the suture-line of a young example was figured by myself in 1921. On account of its apparent restriction to beds II *b* and III in the Isle of Wight, I * took the present species as characteristic of the middle *deshayesi*-beds (*hambrovi*-subzone).

The inner whorls of the form figured by Sinzow (*loc. cit.* 1906, p. 162, pl. i. fig. 7) as *Douvilleiceras meyendorffi* (d'Orbigny) are not comparable to the present species as Sinzow thought.

Horizon and Locality.—Lower Aptian, middle *deshayesi*-zone (*hambrovi*-subzone). Atherfield (beds II *b*–III *b*). Kilian and Reboul † cited this species from the Bedoulian of the south of France; Corroy ‡ listed it from Gurgy (Yonne).

2. *Cheloniceras perli*, sp. n. (Pl. XVI. fig. 6.)

Type.—A body-chamber fragment (M.P.G. no. 31046) from Atherfield, Isle of Wight.

Diagnosis.—Coiling subplaty-pachygyral, sublatumbilicate. Whorl-section transversely oval, greatly depressed; venter widely arched and evenly rounded. Inner whorls probably like those of *Ch. hambrovi*; the ornament soon changes to more or less regularly alternating long and short ribs, blunt and without distinct nodes at the umbilical end. Suture-line unknown, probably as in *Ch. hambrovi*.

Measurements.—

Holotype (M.P.G. no. 31046)	37	·39	·57	·35

Remarks.—This species is close to *Ch. hambrovi* (Forbes), and is connected therewith by transitions (*e.g.*, M.P.G. no. 38046), in which the whorl-section may become as little inflated as in the present form and the ribbing more regular. Another specimen (M.P.G. no. 31047) has even more uniform costation than the holotype of the present species, but it is still costate at nearly 50 mm. diameter, and is so badly worn that it could represent merely the inner whorls of a large *Ch. hambrovi*, with the post-*royerianum* (or "*perli*") stage unusually prolonged and accidentally preserved.

Horizon and Locality.—Lower Aptian, middle *deshayesi*-zone (*hambrovi*-subzone). Atherfield (beds II *b*–III *b*).

* *Loc. cit.* (Summary of Progress, 1922) 1923, p. 147.
† *Loc. cit.* (Aptien Inférieur Montélimar, 1915) p. 50.
‡ *Loc. cit.* (Neocomien Bassin Paris, 1925) p. 309.

3. *Cheloniceras* aff. *gottschei* (Kilian).

1902. *Acanthoceras* (*Parahoplites*) *martini*, d'Orbigny, sp., var. *gottschei*, Kilian, "Aptien in Südafrika," Centralbl. f. Min. &c., p. 465.
1910. *Douvilleiceras martini*, var. *gottschei*, Kilian; Krenkel, "Aptfossilien der Delagoa Bai," Neu. Jahrb. f. Min. &c. (i.) p. 144, pl. xvii. figs. 4, 5, 8, 9.
1921. *Cheloniceras gottschei* (Kilian), Spath, *loc. cit.* (Zululand) p. 312.
1925. *Douvilleiceras martini* (d'Orbigny), var. *gottschei*, Kilian; Burckhardt, *loc. cit.* (Bol. Inst. Geol. Mexico, no. 45) pp. 25, 32.

An example (M.P.G. no. 30969) of about 75 mm. diameter unfortunately only shows the costate body-chamber and traces of the bituberculate inner whorls; but, as far as can be judged, this badly preserved specimen may well be attached to Kilian's form, and shows considerable likeness to the South African specimen figured by the writer in 1921. The species was then discussed in detail.

Another incomplete example (M.P.G. no. 30914), with the bituberculate inner whorls preserved as an impression, shows great resemblance to the Delagoa Bay specimen figured by Krenkel, with merely traces of the earlier tuberculation remaining, and a fairly regular alternation of long and short costæ on the body-chamber.

A specimen in the British Museum (no. 46590 from the Saxby Collection) was previously stated to be almost indistinguishable from the South African example in ornamentation and in suture-line, but to show a more rapid increase in width of the whorl-section. This specimen may be considered to be a passage-form to *Ch. hambrovi*, and it differs from *Ch. perli* chiefly in its wider umbilicus and larger size.

Horizon and Localities.—Lower Aptian (Upper?) *deshayesi*-zone. Isle of Wight and Kent Coast (Hythe Beds).

4. *Cheloniceras* aff. *meyendorffi* (d'Orbigny).

1844. *Ammonites meyendorffi*, d'Orbigny, in Murchison, Verneuil, and Keyserling, Géologie de la Russie, &c., vol. ii. p. 428, pl. xxxii. figs. 4–5.
1906. *Douvilleiceras meyendorffi* (d'Orbigny), Sinzow, *loc. cit.* (*Douvilleiceras* Arten), p. 161, pl. i. figs. 7–9.

A Hythe example (M.P.G. no. 30962) shows resemblance to the large specimen figured by Sinzow, but the characteristic small saddle that subdivides the broad first lateral lobe is wider and more quadrate in the English example. Its position, however, similarly coincides with that of the prominent outer tubercle, whilst the inner node is comparably [illegible] and blunt. The ventral area is slightly less wide than

in the Russian specimen, but the whorl-thickness is 66 per cent. of the diameter, and there is an indication of macrocephalic widening of the aperture. The specimen, however, is still septate at 90 mm. diameter.

In a number of comparable specimens (*e.g.*, B.M. no. C 565) from the Ferruginous Sands of the Isle of Wight the tubercles are smaller, and they may thus represent passage-forms to *Ch. cornuelianum*, although this has fewer secondary costæ, at least in smaller specimens, and a less inflated whorl-shape.

Horizon and Localities.—Lower Aptian, upper *deshayesi*-zone. Isle of Wight (Ferruginous Sands) and Kent Coast (Hythe Beds).

5. *Cheloniceras cornuelianum* (d'Orbigny).

1841. *Ammonites cornuelianus*, d'Orbigny, Pal. Française, Terr. Crét. p. 364, pl. cxii. figs. 1–2.
1875. *Ammonites cornuelianus*, d'Orbigny; Topley, Geology of the Weald, *loc. cit.* p. 421.
1889. *Ammonites cornuelianus*, d'Orbigny; Bristow &c., Geology Isle of Wight, 2nd ed. p. 266.
1915. *Douvilleiceras cornuelianum* (d'Orbigny), Kilian & Reboul, *loc. cit.* (Aptien Inférieur Montélimar) p. 52.
1915. *Douvilleiceras cornueli* (d'Orbigny), Nikchitch, "*Douvilleiceras* de l'Aptien du Caucase," Mém. Com. Géol. n. s. livr. cxxi. p. 10, pl. i. figs. 1–5.
1924. *Cheloniceras cornuelianum* (d'Orbigny), Spath, *loc. cit.* (Speeton Clay) p. 79.
1925. *Cheloniceras cornuelianum* (d'Orbigny), Spath, *loc. cit.* (in Walton, Folkestone) p. 31.
1925. *Cheloniceras cornuelianum* (d'Orbigny), Dutertre, *loc. cit.* (Ann. Soc. Géol. Nord, vol. xlix.) p. 240.

This well-known species is abundantly represented. Typical specimens of the size of d'Orbigny's holotype are easily identified, but at larger diameters the number of inner tubercles increases considerably, and the ribs of the umbilical wall are very oblique and inclined backwards. This is particularly noticeable in umbilical casts (*e.g.*, L.F.S. no. 639, from Whale Chine), although these cannot, perhaps, be definitely identified. At the same time the secondaries multiply, and finally only single and untuberculate ribs remain. The identification of isolated body-chambers is thus very difficult.

Some poorly preserved specimens from the Ferruginous Sands of the Isle of Wight (*e.g.*, B.M. no. C 888) resemble the outer whorl of the evolute variety figured by Sinzow *,

* *Loc. cit.* (*Douvilleiceras*-Arten, 1906) p. 158, pl. i. fig. 1.

but on account of the presence of a distinct peripheral tubercle there is less danger of confusion with the somewhat similar evolute *Procheloniceras albrechti-austriæ* (*e. g.*, B.M. no. 73585). On the other hand, a large Hythe example in the British Museum has similar overhanging inner and small outer tubercles. *Crioceras* (*Ammonitoceras*) *transcaspium*, Sinzow, discussed below, would probably also develop a similar outer whorl. Some fragmentary and crushed examples (M.P.G. nos. 37727–8) of the same type, said to be from the "Undercliff," Isle of Wight, and preserved in a light glauconitic matrix, may also belong to this form.

The "*Amm. cornuelianus*" from Upware figured by Keeping has already been referred to (see p. 440) as belonging to quite a different group.

Horizon and Localities.—Lower Aptian, upper *deshayesi*-zone, and lower part of Upper Aptian. Isle of Wight (Ferruginous Sands), Kent Coast (Hythe Beds), Bensted's Quarry, Aylesford, and Hunstanton, Norfolk (base of "Carstone"). A transition to *Ch. crassum* from the Toulmin Smith Collection (B.M. no. 48061) is from Boughton, near Maidstone, Kent.

6. *Cheloniceras kiliani* (v. Koenen).

1902. *Acanthoceras kiliani*, v. Koenen, *loc. cit.* (Ammonitiden Nordd. Neocom.) p. 406, pl. xxxiii. figs. 1–3.
1915. *Douvilleiceras kiliani* (v. Koenen), Kilian & Reboul, *loc. cit.* (Aptien Inférieur Montélimar) p. 51.
1921. *Cheloniceras kiliani* (v. Koenen), Spath, *loc. cit.* (Zululand) p. 314.

This species does not seem to differ much from *Ch. cornuelianum* (d'Orbigny), but is now retained for those examples (*e.g.*, L.F.S. no. 924) in which bituberculation is lost comparatively early and is replaced by very irregular costation, with scarcely two consecutive ribs of a similar thickness. In the case of very large examples, such as are known from the Isle of Wight, specific distinction from other forms of *Cheloniceras* may be impossible.

In a Hunstanton specimen in the Lamplugh Collection (B.M. no. C 32334) the *royerianum*-like inner whorls are shown, and the costation is more irregular than that of the associated *Ch. cornuelianum* (*e.g.*, B.M. no. C 26236), already at a small diameter. *Ch. seminodosum* (Sinzow), from the same deposit, is less tuberculate.

An example from Mr. Perl's collection (no. 644, marked "just below top of VII, at Ladder Chine") is more inflated than v. Koenen's type.

Horizon and Locality.—Lower Aptian (upper *deshayesi*-zone) and base of Upper Aptian (*martini*-zone). Isle of Wight (Ferruginous Sands); Hunstanton, Norfolk (base of Carstone).

7. *Cheloniceras crassum*, sp. n. (Pl. XV. fig. 6.)

Type.—The Hythe example in the Manchester Museum (no. L 11605) here figured.

Diagnosis.—Like *Ch. cornuelianum* (d'Orbigny), but with coarser and more distant ribbing, wider periphery, and greatly exaggerated lateral tuberculation. Suture-line with median saddle of the lateral lobe outside rather than inside position of lateral tubercle.

Mesurements.—

Holotype (Pl. XV. fig. 6)	75	·40	·71	·33
B.M. no. 48061 (transition to *Ch. cornuelianum*)	85	·40	·68	·35

Remarks.—This species is connected with the last and *Ch. cornuelianum* by various passage-forms (*e.g.*, M.P.G. no. 30963), and, like these two forms, it loses its extremely pronounced tuberculation at larger diameters. An example (B.M. no. C 2561), of over 100 mm. diameter, with nearly half a whorl of body-chamber shows smaller and more irregular tubercles near the end; but in the case of very large examples, such as those mentioned on p. 444, specific identification would be difficult without breaking up the specimens. In fragments of a gigantic Hythe specimen, for example (B.M. no. C 8030), it is only the great whorl-thickness (140 mm., as compared with a height of 60 mm. in the median plane) that suggests reference to *Ch. crassum*, since other fragments (*e.g.*, B.M. no. 5921), doubtfully attached to *Ch. cornuelianum*, are far less depressed.

In a Hunstanton fragment (B.M. no. C 29618), with the whorl-thickness more than double the height, the internal as well as the external suture-lines are visible. The latter agree with the suture-line of *Ch. cornuelianum* (d'Orbigny) figured by Sinzow *, but the position of the median saddle in the lateral lobe agrees with that of the outer tubercle. The inner tubercle, which is very close to the outer, is more distinct in this fragment than in the holotype.

Horizon and Localities.—Lower Aptian, upper *deshayesi*-zone (and lower part of Upper Aptian ?). Hythe, Kent; Hunstanton, Norfolk (base of "Carstone"); Isle of Wight (Ferruginous Sands).

* *Loc. cit.* (*Douvilleiceras*-Arten, 1906) p. 160, text-fig. 1.

8. *Cheloniceras* aff. *seminodosum* (Sinzow).

1906. *Douvilleiceras seminodosum*, Sinzow, *loc. cit.* (*Douvilleiceras*-Arten) p. 165, pl. i. figs. 3–6.
1913. *Douvilleiceras seminodosum*, Sinzow; Kilian, *loc. cit.* (Lethæa) p. 340. pl. ix. fig. 1.
1915. *Douvilleiceras seminodosum*, Sinzow; Nikchitch, *loc. cit.* (Mém. Com. Géol.) p. 20, pl. i. fig. 9, pl. ii. fig. 1.
1921. *Cheloniceras seminodosum* (Sinzow), Spath, *loc. cit.* (Zululand) pp. 313, 317.

Fragments of *Cheloniceras* that may belong to this species have been collected in top IV (*grandis*-bed) of the Isle of Wight (L.F.S. no. 641), but a Hunstanton example (B.M. no. 88983), in a better state of preservation, shows very good agreement with Sinzow's fig. 4 *a*. It is still septate at 65 mm., but since Sinzow's figure is reduced (× ½), the resemblance may not be so great at a comparable size. The other forms figured by this author, in any case, are less closely comparable, but Kilian's large form may have similar inner whorls.

Horizon and Localities.—Lower Aptian, upper *deshayesi*-zone, Isle of Wight (bed IV), and Hunstanton, Norfolk (base of "Carstone").

9. *Cheloniceras martini* (d'Orbigny).

1841. *Ammonites martini*, d'Orbigny, Pal. Française, Terr. Crét. i. p. 194, pl. lviii. figs. 7, 8, 10.
1875. *Ammonites martini*, d'Orbigny; Topley, Geology of the Weald, p. 421.
1913. *Douvilleiceras martini* (d'Orbigny), Kilian, *loc. cit.* (Lethæa) p. 340.

The identification of immature specimens like those figured in Pl. XIV. figs. 4 & 6 is very difficult, for the young of *Ch. subnodosocostatum* or of *Ch. tschernyschewi* (Sinzow) are essentially similar, as mentioned below. The larger (fig. 6) might even be a young *Ammonitoceras*, but has the characteristic flattened costation. The specimen represented in Pl. XIV. fig. 7 (M.P.G. no. 30964) seems to agree with d'Orbigny's type-figure, but an early mutation or perhaps a distinct passage-form to *Ch. cornuelianum* occurs already at a presumably much lower level. One such example from the "Hythe Beds" of the Town Malling Quarry, near Maidstone (B.M. no. C 14668), is still septate at 70 mm. diameter, and therefore not only larger, but also slightly more coarsely ribbed than the true *Ch. martini*. On the [illegible] the peripheral bullæ and two intermediate ribs

of the ventral area are typically developed, and only the persisting large outer tubercle still recalls the earlier *Ch. cornuelianum*. This is probably the "*Amm. martini*" generally quoted from the Hythe Beds.

Another new form of this group with very depressed whorl-section is before me from the River Clekma, near its junction with the Lena, Irkutsk, Siberia (B.M. no. C 7169).

The var. *orientalis*, Jacob *, which also has a depressed whorl-section, does not seem to occur in the English Aptian. It somewhat resembles, however, the small example figured by d'Orbigny in his fig. 9 (pl. lviii.), which was correctly excluded from the true *Ch. martini* already by Sinzow †. Dr. Kitchin ‡ compared to this small example an ammonite from the Atherfield Clay in the Dover Boring, but this is too low a horizon for the true *Ch. martini*, and, with Sinzow, I would attach forms like d'Orbigny's small example to *Ch. cornuelianum* rather than to *Ch. martini*, var. *occidentalis*, Jacob §.

Horizon and Localities.—Upper Aptian, *martini*-zone. Hythe and Maidstone, Kent; Isle of Wight (Ferruginous Sands).

10. *Cheloniceras* aff. *tschernyschewi* (Sinzow).

1906. *Douvilleiceras tschernyschewi*, Sinzow, *loc. cit.* (*Douvilleiceras*-Arten) p. 182, pl. ii. figs. 11–12, pl. iii. figs. 2–7.
1906. *Douvilleiceras tschernyschewi*, var. *laticostata*, Sinzow, ibid. pl. iii. fig. 1.
1913. *Douvilleiceras tschernyschewi*, Sinzow; Kilian, *loc. cit.* (Lethæa) p. 340 (pars).
1915. *Douvilleiceras tschernyschewi*, Sinzow; Nikchitch, *loc. cit.* (Mém. Com. Géol.) p. 25, pl. ii. figs. 2–9, pls. iii.–v.
1921. *Cheloniceras tschernyschewi* (Sinzow), Spath, *loc. cit.* (Zululand) p. 317.

There are various large examples that resemble the var. *laticostata* of this species figured by Sinzow, but the inner whorls of one of these (B.M. no. C 992, still septate at over 150 mm. diameter) show the *martini*-stage persisting only to about 30 mm. Such inner whorls may, of course, easily be misidentified, but the correct determination of body-chamber fragments, showing untuberculate and close ribbing,

* In Jacob and Tobler, *loc. cit.* pl. i. figs. 1–3, *e. g.*, B.M. no. C 25241 from the Luitere Zug, Switzerland; non Kilian, *loc. cit.* (Lethæa, 1913) pl. x. figs. 6 *a*, *b*.

† *Loc. cit.* (*Douvilleiceras*-Arten, 1906) p. 171 (in synonymy).

‡ In Lamplugh and Kitchin, *loc. cit.* (Mem. Geol. Survey, 1911) p. 109.

§ See Roch, *loc. cit.* (Mém. Soc. géol. France, n. s. vol. iv. 1927) p. 19.

is even less certain. The Allington and Aylesford examples listed below are such doubtful large forms, and both had been referred by Crick to "*Macroscaphites*" *hillsi*, although they are not identical. The former is still septate at 180 mm. diameter, but the second is completely chalcedonized. This preservation, reminiscent of the Upper rather than the Lower Greensand, directs attention also to the great external similarity that exists between these forms and very large Cenomanian *Eucalycoceras* of the type of *Eu. newboldi* (Kossmat).

Horizon and Localities.—Upper Aptian, *martini*-zone (and top of Lower Aptian ?). Isle of Wight (Ferruginous Sands); Maidstone, Allington, Kent (Hofman's Quarry, fourteenth lane from top); Aylesford, Kent (Bensted's Quarry, and doubtfully from a gravel with flint-implements, overlying the Folkestone Sands).

11. *Cheloniceras* aff. *subnodosocostatum* (Sinzow).

1906. *Douvilleiceras subnodosocostatum*, Sinzow, *loc. cit.* (*Douvilleiceras*-Arten) p. 175, pl. ii. figs. 1–8.
1913. *Douvilleiceras subnodosocostatum*, Sinzow; Kilian, *loc. cit.* (Lethæa) p. 340 (footnote).
1915. *Douvilleiceras subnodosocostatum*, Sinzow; Nikchitch, *loc. cit.* (Mém. Com. Géol.) p. 40, pl. vi. figs. 4–7.
1923. *Diadochoceras subnodosocostatum* (Sinzow), Spath, *loc. cit.* (Summary of Progress, 1922) p. 148.

Sinzow (p. 173) considered Forbes's * figured example to belong to *Ch. subnodosocostatum* or to *Ch. tschernyschewi*, since Forbes stated that his *Amm. martini* grew to a considerable size, whereas the true *Ch. martini* remained small. Sinzow was probably right, and the inner whorls of *Ch. tschernyschewi* are certainly very similar to Forbes's example; but there are many such immature *Cheloniceras* in the English Aptian, and specific identification is often impossible.

A larger example (M.P.G. no. 30913) seems to agree with Sinzow's fig. 4 (pl. ii.), but it still retains intermediate ribs, whilst in the typical *Ch. subnodosocostatum*, these are lost altogether on the outer whorls. There is nothing known to me from the Lower Greensand resembling topotypes (*e.g.*, B.M. no. C. 25242) of the form figured by Jacob and Tobler † as *Douvilleiceras subnodosocostatum*; and if their identifications were correct, Forbes's and other similar British

* *Loc. cit.* (Quart. Journ. Geol. Soc. vol. i.) pl. v. fig. 3.
† *Loc. cit.* (Engelberger Aa, 1906) p. 14, pl. i. figs. 4–5.

examples would not belong to the present species. On the other hand, Sinzow's fig. 8 *c* is very close to *Ch. tschernyschewi* (his fig. 11), and these (presumably earlier) forms are apparently not represented in the Luitere Zug fauna. A number of Colombian * examples in the British Museum (*e.g.*, nos. C 4305 *a*, *b*), however, do not differ from the example here figured in Pl. XIV. fig. 4, except, perhaps, in whorl-section. But there are considerable differences in this respect also among the immature British forms, and the original of Forbes's lower figure (specimen no. R 2284 B, Geol. Soc. Coll.) is thinner than the more favourably preserved larger example (R 2284 A), which agrees with the specimen here figured.

What may be an entirely new species of the same group as *Ch. subnodosocostatum* is represented by an example (B.M. no. C 2531) from east of Ladder Chine, Isle of Wight. It is almost complete at only 35 mm. diameter, and almost untuberculate.

Horizon and Localities.—Upper Aptian, *martini*- and *subnodosocostatum*-zones. Isle of Wight (Blackgang).

12. *Cheloniceras* sp. juv. (Pl. XIV. fig. 3.)

The small Hythe example (Manchester Mus. no. L 11608) here figured (and enlarged two diameters) does not seem to be the young of *Ch. cornuelianum*, which is the commonest form of *Cheloniceras* in the Hythe Beds. It is more compressed (with whorl-height about 7 mm. as against 10 mm. thickness), and the lateral tubercle becomes faint and close to the periphery towards the end. There is no resemblance either to the immature *Ch. tschernyschewi* and *Ch. subnodosocostatum* above discussed, or to young examples of the *martini* group from the Gargasian of the Basses Alpes (*e.g.*, B.M. nos. C 5904 *a*, *b*). On the other hand, a Blackgang specimen of *Ch.* aff. *martini* (B.M. no. C 888), with a similarly thin whorl-section, differs mainly in the flattening of its ribs, and it is possible that the example here figured is the young of one of those passage-forms between *Ch. cornuelianum* and *Ch. martini* referred to on p. 450.

Horizon and Locality.—Lower Aptian, upper *deshayesi*-zone, Hythe, Kent (Hythe Beds).

* Several *Cheloniceras* from Colombia have recently been figured and described by Mlle E. Basse ("Quelques Invertébrés Crétacés de la Cordillère Andine," Bull. Soc. Géol. France, (4) vol. xxviii. 1928, pp. 138–142.

Family III. Ancyloceratidæ, Hyatt, 1900, emend.

Genus ANCYLOCERAS, d'Orbigny, 1842.

1. *Ancyloceras matheronianum*, d'Orbigny.

1842. *Ancyloceras matheronianum*, d'Orbigny, Pal. Française, Terr. Crét. i. p. 447, pl. cxxii.
1889. *Ancyloceras matheronianum*, d'Orbigny; Bristow, &c., Geology Isle of Wight, 2nd ed. p. 266.
1927. *Ancyloceras matheronianum*, d'Orbigny; Roch, *loc. cit.* (Mém. Soc. Géol. France, n. s. vol. iv.) p. 23.

This species, recently discussed in detail by Roch, is represented by the single example figured by Mantell, and referred to on p. 421, the only ammonoid known to me from the *Perna*-beds of Atherfield. It is not restricted to this horizon apparently, for Kilian * records it together with *Parahoplitoides consobrinus* (d'Orbigny).

Horizon and Locality.—Lower Aptian, lower *deshayesi*-zone (*Perna*-beds), Atherfield, Isle of Wight. This is apparently on a lower level than the "*Perna*-bed" of Woodhatch, near Reigate, Surrey.

2. *Ancyloceras* aff. *varians*, d'Orbigny.

1842. *Ancyloceras varians*, d'Orbigny, Pal. Française, Terr. Crét. i. p. 504, pl. cxxvi.
1913. *Ancyloceras varians*, d'Orbigny; Kilian, *loc. cit.* (Lethæa) p. 351.
1915. *Ancyloceras varians*, d'Orbigny; Kilian & Reboul, *loc. cit.* (Aptien Inférieur Montélimar) p. 68.
1924. *Ancyloceras varians*, d'Orbigny; Spath, *loc. cit.* (Speeton Clay) p. 79.
1925. *Ancyloceras varians*, d'Orbigny; Corroy, *loc. cit.* (Néocomien Bassin Paris) p. 310.

This species, like the last, is represented by an unique example, a doubtful fragment in the Sedgwick Museum, associated with the similarly incomplete *Ancyloceras*, sp. n., listed from the Hunstanton "Carstone," which may be figured on another occasion.

Horizon and Locality.—Lower Aptian, *deshayesi*-zone. Hunstanton (base of "Carstone").

Genus EPANCYLOCERAS, nov.

Holotype.—*Epancyloceras hythense*, sp. n. (Pl. XV. figs. 3 *a*, *b*), from the Lower Aptian of Hythe, Kent.

* *Loc. cit.* (Lethæa, 1913) p. 344.

Diagnosis.—Ancyloceratids with two rows of lateral tubercles and a median row of siphonal tubercles on the principal ribs, and two or three slender and irregular intermediaries. Suture-line with three bifid saddles and four lobes (I, U, L, E), apparently similar to that of *Ancyloceras*, s. s.

Remarks.—The unique Hythe example here figured consists of the earlier part of the body-chamber, but there is a larger fragment in the British Museum (no. 74972, from Basle, ex Van Breda Coll.) which belongs to an allied species. This is still septate at 150 mm., has crioceratid coiling, and shows loss of first the ventral sharpening and then of the outer lateral tubercles before the final stage, at which the venter becomes broadly rounded and the whorl-section comparable almost to that of *Hamulina dissimilis* (d'Orbigny) *. There does not seem to be any described species that agrees with the forms here discussed. *Epancycloceras* is taken to be a development of the same stock that produced *Ancyloceras* and the other genera here described, but on account of the sharpening of the ventral area alone a separate name is advisable.

1. *Epancyloceras hythense*, sp. n. (Pl. XV. figs. 3 *a*, *b*.)

Type.—The Hythe example (Manchester Museum, no. L 11609, ex Dixon Coll.), figured in Pl. XV. figs. 3 *a*, *b*.

Diagnosis.—See generic diagnosis above. The dorsal area shows striation continuous across the narrow antisiphonal groove. There are about three of these striæ meeting at each lateral tubercle and two or three intermediate ones, and they all describe a Cupid's bow (directed forward) across the dorsum.

Remarks.—The swelling of the ribs in the siphonal line is as marked at the end of the body-chamber as at the beginning, where the final septal surface displays the saddles fairly well, though the lobes are worn. On account of its small size it is difficult to compare the present species with the gigantic "*Crioceras*" *lahuseni* figured by Sinzow †. The similarity of the younger whorls of this species to the Basle example of *Epancyloceras*, referred to above, suggests that the unknown early stage of Sinzow's form may be comparable, and that this should therefore be classed with *Epancyloceras*, but the adult is quite different.

* *Loc. cit.* (Pal. Française, Terr. Crét. i.) 1842, pl. cxxx. fig. 7.

† *Loc. cit.* (*Douvilleiceras*-Arten 1906) pl. v. figs. 3 *a*–*c*.

Genus TROPÆUM, J. de C. Sowerby, 1837.

1. *Tropæum bowerbanki* (J. de C. Sowerby).

1837. *Crioceratites bowerbanki*, J. de C. Sowerby, "Letter to the Secretary &c.," Trans. Geol. Soc. (ii.) vol. iv. p. 409, pl. xxxiv.
1847. *Crioceratites bowerbanki*, J. de C. Sowerby in Fitton, *loc. cit.*, Quart. Journ. Geol. Soc. vol. iii. p. 303, text-figs. 1, 2.
1875. *Crioceras* (*Tropæum*) *bowerbanki* (Sow.), Topley, Geology of the Weald, p. 422.
1889. *Crioceras* (*Ancyloceras*) *bowerbanki* (Sow.), Bristow, &c., Geology Isle of Wight, 2nd ed. p. 266.
1902. *Crioceras bowerbanki* (Sow.), v. Koenen, "Amonitiden d. Nordd. Neocom," *loc. cit.* p. 247, pl. xxxvii. fig. 4, pl. xlii. fig. 2.
1913. *Ancyloceras bowerbanki* (Sow.), Kilian, *loc. cit.* (Lethæa) p. 352.
1917. *Crioceratites bowerbanki*, J. de C. Sowerby; Crick, "Note on Type-specimen &c.," Proc. Malac. Soc. vol. xii. pt. 4, p. 138, pl. vii.
1926. *Tropæum bowerbanki* (J. de C. Sowerby), Whitehouse, *loc. cit.* (Mem. Queensl. Mus. vol. viii.) p. 213.

The type of this species was recently again discussed and well refigured by Crick. There is a fine series of specimens in the British Museum, and they all differ slightly in proportions and coiling. An Ahaus (Westphalia) example (B.M. no. C 32359) with a very old label "*Crioceras ahausensis*, sp. nov." is also typical, but it is more evolute than v. Koenen's equally large specimen, though less uncoiled than his "*Ancyloceras*" *hillsi* from the same locality.

Among the typical examples from Russia figured by Sinzow * the original of his pl. xvi., fig. 4 in coiling forms a transition to *T. hillsi*. This, however, does not seem to differ sufficiently in suture-line to allow of the correct identification of fragments, as Sinzow thinks.

Kilian considered this species identical with *Ancyloceras simbirskense*, Jasikov (Sinzow), but, as mentioned below, the Russian form is more closely comparable to *T. gigas* at a corresponding diameter.

Horizon and Localities.—Upper Aptian, *martini*-zone (and top of Lower Aptian ?), "*Scaphites* Group" (V) of Fitton, Isle of Wight (especially Whale Chine), Hythe (Kentish Rag), Hunstanton (base of Carstone) †.

2. *Tropæum hillsi* (J. de C. Sowerby).

1836. *Hamites hillsii*, J. de C. Sowerby, in Fitton, *loc. cit.* (Trans. Geol. Soc. (2) vol. iv.) p. 128.
1836. *Scaphites hillsii* (J. de C. Sowerby), ibid. p. 339, pl. xv. figs. 1, 2, 3.

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* *Loc. cit.* (Mat. Geol. Russl. vol. xxii. 1905) p. 327, pls. xv.–xvii.

† One fragment in the British Museum (no. C 26235), showing the [illegible] and suture-line of v. Koenen's fig. 2 *a*, pl. xlii.

1847. *Scaphites hillsii* (J. de Sowerby), in Fitton, "Section at Atherfield" (Quart. Journ. Geol. Soc. vol. iii.), p. 303, fig. 3.
1875. *Ancyloceras (Scaphites) hillsii* (Sowerby), Topley, Geology of the Weald, p. 421.
1898. *Macroscaphites gigas* (J. de C. Sowerby), Crick, "Muscle Impress, &c.," Trans. Linn. Soc. ser. 2, vol. vii. p. 31, pl. xvii. figs. 17–19.
1925. *Tropæum hillsi* (J. de C. Sowerby), Spath, in Walton, 'Folkestone,' p. 31.

The specimen represented in Sowerby's pl. xv. fig. 3 from Sir Phillip Egerton's Collection is in the British Museum (no. C 446), but its inner whorls are replaced by crystalline calcite and unrecognizable. The missing smaller example illustrated in fig. 1 and the doubtful Lympne fragment here figured (Pl. XV. fig. 2) show the ribbing rather too coarse, and in von Koenen's Ahaus specimen * the costation also is badly restored. Sinzow's † Russian examples, however, are typical, and his fig. 5 especially represents the characteristic trapezoidal whorl-section. There are many transitions to *T. bowerbanki*, which was, indeed, considered by Forbes to belong to the same species, and it is doubtful whether the supposed simpler suture-line of *T. hillsi* forms as good a distinguishing feature as Sinzow believed. In typical Lympne (B.M. no. C 32358) and Atherfield examples (L.F.S. nos. 672–3) the suture-line is as complex as that of v. Koenen's Ahaus form or of the typical *T. bowerbanki*.

Sowerby's *Hamites grandis* is not based on a portion of the straight shaft of *T. hillsi* as Kilian ‡ implies. On the other hand, Krenkel's § *Ancyloceras fallauxi* (Uhlig), var. *mozambiquense*, which does not appear to be related to Uhlig's ‖ species, may well be compared to typical fragments of the present form from the Isle of Wight.

The fragments of *Tropæum* before me from the Wissant Sands of Nesles and Neufville ¶ are not complete enough to be definitely referred to the present species.

Horizon and Localities.—Upper Aptian, *martini*-zone (and top of Lower Aptian ?), "*Scaphites*-Group" (V) of Fitton, Isle of Wight, Kentish Rag (Hythe and Bensted's Quarry, Aylesford, near Maidstone).

* *Loc. cit.* (Ammonitiden der Nordd. Neocom.) 1902, pl. xxxiii. fig. 4.

† "Ueber einige evolute Ammoniten-Formen aus dem oberen Neocom Russlands," Mat. z. Geol. Russl. vol. xxii. 1905, p. 327, pl. xv. figs. 1–3, 5, 6, pl. xvii. fig. 7, pl. xxii. fig. 6.

‡ *Loc. cit.* (Lethæa, 1913) p. 352.

§ *Loc. cit.* (Neu. Jahrb. 1910, i.) p. 153, pl. xvii. figs. 2, 3.

‖ *Loc. cit.* (Wernsdorfer Schichten, 1883) p. 141, pl. xxix. fig. 1.

¶ See Dutertre, *loc. cit.* (Ann. Soc. Géol. Nord, vol. xlix.) p. 242.

3. *Tropæum gigas* (J. de C. Sowerby). (Pl. XVII. fig. 3.)

(?) 1828. *Hamites gigas*, J. de C. Sowerby, Min. Conchology, vol. vi. p. 188, pl. dxciii. fig. 2.
1840. *Scaphites gigas* (J. de C. Sowerby), *loc. cit.* Trans. Geol. Soc. [2] vol. v. p. 411, pl. xxxiv. figs. 2, 2 *a*.
1847. *Scaphites gigas* (J. de C. Sowerby), in Fitton, *loc. cit.* (Quart. Journ. Geol. Soc. vol. iii.) p. 303, text-fig. 4.
1875. *Ancyloceras* (*Scaphites*) *gigas* (Sowerby), Topley, Geology of the Weald, p. 421.
1926. *Australiceras* (?) *gigas* (J. de C. Sowerby), Whitehouse, *loc. cit.* (Mem. Queensl. Mus. vol. viii.) p. 207.

The missing holotype (? *Ancyloceras*) from the Hythe Beds was only a body-chamber fragment, and the larger specimen figured in 1840 (now B.M. no. 46473) does not show the early whorls. Neumayr * wrote that a cast of this form showed the ribs of the spiral portion bundled in umbilical tubercles. But it may be surmised that the original was artificially carved in an attempt to improve its appearance (as is the case with various examples in the British Museum), and in, *e. g.*, the casts of *Ancyloceras gigas* supplied by Krantz the inner whorls are certainly most misleadingly restored (*e. g.*, Birkbeck College cast). Unfortunately among the many typical specimens examined there is not one that has the inner whorls well preserved, so that, apart from the slightly coarser costation, an example like that here figured might equally well have been referred to either of the two forms of *Tropæum* above discussed. Even the specimen in the Sedgwick Museum, recorded by Dr. Whitehouse, was only doubtfully attached to this species. Its earliest volutions are not visible, and the partial trituberculation seen on the inner whorls here illustrated is not taken to be of generic significance.

This small example begins with a toxoceratid open curve of rounded section, and with oblique close costation as in "*Ancilоceras*" *simbirskense*, Jasikov †, or *A. gracile*, Sinzow ‡. Then there follows a trituberculate stage, as in typical *Australiceras*, for another three-quarters of a turn, and, finally, on the last third of the outer whorl there is the usual fine, close, and rursiradiate *Tropæum* ribbing. It is probable that ornamentation and coiling are equally unstable in the closely allied *Ancyloceras renauxianum*, d'Orbigny §, which, according to Sinzow ||, was incorrectly drawn. The separation

* *Loc. cit.* (Ammonit. Hilsbild. Nordd.) 1881, p. 191.
† See Sinzow, Mater. Geol. Russl. vol. iv. 1872, p. 33, pl. vi. fig. 1.
‡ *Ibid.* pl. vi. fig. 5.
§ Pal. Française, Terr. Crét. i. 1842, p. 499, pl. cxxiii.
|| "[illegible] Bemerkungen, &c.," Verh. Russ.-Kais. Min. Ges. [illegible], p. 189.

of the present species from Kilian's * group of *Ancyloceras renauxianum*, and the inclusion in the group of the typical *Ancyloceras matheronianum* (=*Ancyloceras*, s. s.) is thus not accepted.

Horizon and Localities.—Upper Aptian, *martini*-zone (and top of Lower Aptian ?), "*Scaphites*" Group (V) of Fitton, Isle of Wight. Kent, Hythe and Sevenoaks (well bored to 90 ft. through Kentish Rag, on Crockham Hill; B.M. no. C 11208).

4. *Tropæum* cf. *gracile* (Sinzow).

1924. *Ancyloceras* cf. *gracile* (Sinzow), Spath, *loc. cit.* (Speeton Clay) p. 79.

1926. *Australiceras gracile* (Sinzow), Whitehouse, *loc. cit.* (Mem. Queensl. Mus. vol. viii.) p. 212.

The original *Anciloceras gracile*, Sinzow † cannot be separated generically from *T. gigas* and *T. simbirskensis*, discussed above. There is no reason to suppose that Sinzow interpreted his species differently in 1905 ‡, and Dr. Whitehouse's lectotype (pl. xviii. fig. 1) must be assumed to have a loosely coiled or curved beginning, unlike what I would consider to be typical *Australiceras*. The four specimens in the Sedgwick Museum referred to by Dr. Whitehouse are as uncertain as is his own Queensland form (pl. xxxiv. fig. 4), but there is a large Maidstone form before me (B.M. no. C 2502) which may well be compared to the lectotype of Sinzow's species. It is still septate at 330 mm. diameter, and neither the earliest whorls nor the final shaft are known. The costation is fine and close, but where the inner whorls begin to emerge from the matrix that covers the centre they seem to show a bundling as in the somewhat similar "*Crioceras*" *carinato-verrucosum*, Sinzow (pl. xxi. fig. 1). The identification of this example also is thus provisional.

Horizon and Localities.—Upper Aptian, lower part. Hunstanton (base of "Carstone") and Maidstone (so-called "Hythe Beds"). A small fragment in the Manchester Museum (no. L 12048, ex Dixon Coll.) that may also belong to this species is apparently from the true Kentish Rag at Hythe.

5. *Tropæum* sp. ind. (Pl. XV. fig. 2.)

Another species of *Tropæum* is represented by a septate example (B.M. no. 46493) of 140 mm. diameter, which, in

* *Loc. cit.* (Lethæa, 1913) p. 351.

† *Loc. cit.* (Mat. Geol. Russl. vol. iv.) 1872, p. 35, pl. vi. figs. 5, 6, 10, 11.

‡ *Loc. cit.* (*ibid.* vol. xxii. (2)) p. 306, pl. xvii. figs. 1–4, pl. xviii. figs. 1–5, pl. xix. fig. 1.

the comparative coarseness of the ribbing of the earlier whorls as compared with the latter, resembles *Crioceras arcticum*, Stolley *. This is probably a form of the *bowerbanki-hillsi* group, as its author and Dr. Whitehouse † thought, but the coarsely ribbed inner whorls of the English example are quite unlike those of the other species of *Tropæum* here described, and suggest comparison with the equally bluntly costate but hook-shaped *Tonohamites decurrens* (Roemer) discussed below. Since the inner whorls of Stolley's form are unknown, and since only one imperfect example of the English species is available, the identification must remain uncertain.

Horizon and Locality.—Upper Aptian, probably *nutfieldiensis*-subzone. Locality unrecorded (Nutfield, Surrey?).

Genus Ammonitoceras, Dumas, 1876.

1. *Ammonitoceras tovilense*, Crick.

1916. *Ammonitoceras tovilense*, Crick, Proc. Malac. Soc. vol. xii. p. 118, pl. vi.
1923. *Ammonitoceras tovilense*, Crick; Spath, *loc. cit.* (Summary of Progress, 1922) p. 147.
1925. *Ammonitoceras tovilense*, Crick; Burckhardt, *loc. cit.* (Bol. Inst. Geol. Mexico, no. 45) p. 40.

This seems to be the only typical English *Ammonitoceras* so far known. I used it (in the absence of a more suitable fossil) to characterize the upper "Hythe Beds" of the Maidstone District, which may include the equivalents of Sandgate Beds of other areas; but I do not think that Dr. Whitehouse ‡ was right in considering *Ammonitoceras* to replace *Tropæum* in time, or in declaring *Tropæum* to be a descendant of *Australiceras*, which is probably not very different in age from the other two. It is not certain that Kilian § was wrong in considering at least some of his *Ammonitoceras* to be derived from the Cheloniceratids (*i. e.*, his "*Douvilleiceras*"), and the inclusion of this genus in Ancyloceratidæ is provisional. But the present species and a comparable gigantic *Ammonitoceras* from Portuguese East Africa (B.M. no. C 25341) are believed to be Ancyloceratids.

* "Kreideformation und ihre Fossilien auf Spitzbergen," K. Sv. Vet. Handl. vol. xlvii. no. 11, 1912, p. 16, pl. i. fig. 1, p. 27, text-fig. 2.

† *Loc. cit.* (Mem. Queensl. Mus. vol. viii.) 1926, p. 213.

‡ *Loc. cit.* (Mem. Queensl. Mus. vol. viii.) 1926, pp. 208–213.

§ *Loc. cit.* (Lethæa, 1910) p. 276; but forms like *A.* ? ("*Crioceras*") [illegible] Sinzow, *loc. cit.* (*Douvilleiceras* [illegible], 1905, pl. v. fig. 3) also [illegible] *Epancyloceras* (see p. 455).

Horizon and Locality.—Upper Aptian (so-called "Hythe Beds"). Maidstone, Kent.

Genus Tonohamites, Spath, 1924.

1. *Tonohamites decurrens* (Roemer).

1841. *Hamites decurrens*, Roemer, Nordd. Kreidegebirge, p. 92, pl. xiv. fig. 6.
1902. *Hamites decurrens*, Roemer; v. Koenen, *loc. cit.* (Ammonitiden Nordd. Neocom.) p. 392, pl. xxxiii. figs. 2, 3 *a*, *b*.
1924. *Hamites decurrens*, Roemer; Spath, *loc. cit.* (Speeton) p. 85.

Three examples in the British Museum (nos. C 892 *c*, *d*, C 3671) are comparable to the earlier half of v. Koenen's figured Ahaus specimen, but they are too incomplete for definite identification. A still more doubtful and worn example from the Wicken Beds was recorded by Keeping * as "*Ancyloceras* sp.," and was associated with a better second example with fine ribbing, which appears to belong to quite a new form, difficult to place at present.

Horizon and Locality.—Upper Aptian (*martini*-zone), Ferruginous Sands of Blackgang, Isle of Wight.

2. *Tonohamites proteus*, sp. n. (Pl. XVI. fig. 7.)

Type.—The Lympne example (M.P.G. no. 32147) figured in Pl. XVI. fig. 7.

Diagnosis.—Hamitids with tuberculation like that of degenerate *Cheloniceras*, at first more or less distinct, but tendency to develop irregular costation on outer whorl-portions. Ribbing closer than in the untuberculate *T. decurrens* (Roemer).

Remarks.—The example here figured probably represents the final hook of a hamitoid shell. A smaller paratype in the British Museum (no. C 892 *b*) retains at least part of the longer middle limb, and shows that this was parallel to the final limb for at least its own length, as in typical *Hamites*. But the early whorls are missing in all the specimens examined, and may even have resembled the immature *Cheloniceras* (*martini* group?) sp. ind., figured in Pl. XIV. fig. 6. This type of ornamentation persists in some examples to the final shaft. In one specimen traces of bituberculation have been noticed, but as a rule only the lower umbilical tubercle gives rise to branching blunt costæ, with a varying number of single ones between. In the closely allied examples here referred to *T. decurrens* (Roemer) the costation has become single and quite hamitid. Some of

* *Loc. cit.* (Neocomian of Upware) 1883, p. 153.

the specimens are crushed obliquely, and this may account for the somewhat different aspect of all the individuals, but it is not impossible that if complete examples were available they might turn out to belong to more than one species.

Horizon and Localities.—Upper Aptian, *martini*-zone. Lympne, near Hythe, Kent, and Blackgang, Isle of Wight.

3. *Tonohamites*?, sp. n. (Pl. XIV. fig. 5.)

The small fragment here figured probably represents a new species of *Tonohamites* (or *Ancyloceras*?), but it is too incomplete for accurate determination. It is illustrated chiefly because it shows the suture-line, which differs from that of *Tonohamites decurrens* (Roemer) as figured by v. Koenen *, in having a deeper external lobe and plumper saddles. The ribbing is more oblique and less uniformly blunt than in Roemer's species, but the whorl-section is similarly rounded.

Aptian Hamitids are, unfortunately, very rare, and therefore incompletely known. It is probable, however, that forms like *Ptychoceras humboldtianum*, Karsten †, and the *Hamites* sp. figured by Jacob & Tobler ‡ connected the typical Gault forms with the Lytoceratid *Anahamulina* so common in the Upper Barremian.

Horizon and Locality.—Upper Aptian (*martini*-zone). Isle of Wight.

INCERTÆ SEDIS.

Hamites? (gen. nov.?) *grandis* (J. de C. Sowerby). (Pl. XIV. fig. 2.)

1828. *Hamites grandis*, J. de C. Sowerby, Min. Conchol. vol. vi. p. 187, pl. dxciii. fig. 1.
1875. *Ancyloceras* (*Hamites*) *grande* (Sowerby), Topley, Geology of the Weald, p. 421.
1925. *Ptychoceras*, sp. n., Dutertre, "Crétacé Inférieur du Bas-Boulonnais, &c.," Ann. Soc. géol. Nord, vol. xlix. (1924) p. 242.

Sowerby's holotype represents the septate fragment of a large individual, which, like the small French fragment here figured, shows trifid lobes. This prevents comparison with *Ptychoceras* (*puzosianus*-group), which, according to Kilian §,

* *Loc. cit.* (Ammonitiden Nordd. Neocom. 1902) pl. xxxiii. fig. 3 *b*.

† *Loc. cit.* (Géologie de la Colombie, 1886), pl. i. figs. 1 *a–c*. According to an example in the British Museum (no. C 3631) the smaller limb is not always in close contact.

‡ *Loc. cit.* (Engelberger Aa, 1906) pl. ii. figs. 11 *a*, *b*.

§ *Loc. cit.* (Lethaea, 1913) p. 354.

still occurs in the Aptian, and to which I previously attached Dr. Dutertre's fragment. The Hamitids of the Aptian, unfortunately, have not yet been studied in detail, and the promised revision of the Albian forms * must await the completion of the description of the ammonites.

The Aptian forms here discussed, with very oblique costation and circular whorl-section, may be provisionally kept distinct from the Ancyloceratids recorded above.

Kilian † apparently considered *H.? grandis* to represent merely a portion of the straight shaft of a *Tropæum* ‡. In view of the presence of larger nodes in the holotype, it is possible that it may yet turn out to belong to a gigantic species of *Ancyloceras*, comparable to some smaller Bedoule forms recently figured by Roch §, but the specimen here figured is even more distinct. A comparable smooth siphonal line, with slight thickening of the untuberculate ribs on each side of this band, is not found in Bedoule specimens in the British Museum (which also possesses the holotype of Astier's ‖ *Ancyloceras andouli*, generally quoted from Bedoule).

Horizon and Localities.—Upper Aptian, *martini*-zone (Hythe Beds), Smeeth, near Ashford, Kent. Neufville, Boulonnais (Rigaux Coll. in the Musée Géologique at Boulogne).

EXPLANATION OF THE PLATES.

PLATE XIV.

Figs. 1 *a, b. Parahoplites simmsi* (Forbes), nov. Upper Aptian (Sandgate Beds?), Hythe. (M.P.G. no. 2288, Geol. Soc. Coll.) P. 440.

Fig. 2. *Hamites*? (gen. nov.?) cf. *grandis* (J. de C. Sowerby). Upper Aptian, Neufville, Boulonnais. (Rigaux Coll. Musée Géologique, Boulogne.) P. 462.

Fig. 3. *Cheloniceras* sp. juv. Upper Aptian, Hythe Beds, Hythe. (No. L 11608, Manchester Museum.) (Enlarged × 2.) P. 453.

Fig. 4. *Cheloniceras* sp. juv. ("*martini*," Forbes, non d'Orbigny). Upper Aptian, Ferruginous Sands, Atherfield, Isle of Wight. (B.M. no. C 3028.) P. 453.

Fig. 5. *Tonohamites*?, sp. n. Upper Aptian, Ferruginous Sands, Isle of Wight. (M.P.G.) P. 462.

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* See Spath, "Albian Ammonoidea from Portuguese East Africa &c.," Ann. Transv. Mus. vol. xi. pt. 3 (1925), p. 189.

† *Loc. cit.* (Lethæa, 1913) p. 352.

‡ Such fragments occur in the Hythe Beds (*e.g.*, B.M. no. 6144, 8154, from Lympne).

§ *Loc. cit.* (Mem. Soc. Géol. France, vol. viii. 1927) pls. iii., iv.

‖ Catal. descript. *Ancyloceras*, 1851, p. 22, pl. vi. no. 12, pl. vii. no. 12 *bis* (B.M. no. 73806).

Fig. 6. *Cheloniceras* sp. ind. (*martini* group ?). Upper Aptian, Ferruginous Sands, Blackgang, Isle of Wight. (B.M. no. C 26689.) P. 450.

Fig. 7. *Cheloniceras* aff. *martini* (d'Orbigny). Upper Aptian, Ferruginous Sands, Isle of Wight. (M.P.G. no. 30964.) P. 450.

PLATE XV.

Fig. 1. *Deshayesites kiliani*, sp. n. Lower Aptian, *deshayesi*-zone, Atherfield, Isle of Wight. (M.P.G. no. 30922.) P. 429.

Fig. 2. *Tropæum* sp. ind. (*hillsi* group). Aptian, Hythe Beds, Lympne, Kent. (M.P.G. no. 32149.) P. 457.

Figs. 3 *a*, *b*. *Epancyloceras hythense*, sp. n. Aptian, Hythe Beds, Hythe. (Manchester Museum, no. L 11609.) P. 455.

Fig. 4. *Dufrenoyia lurensis* (Kilian). Same bed and locality. (Manchester Museum, no. L 11607.) P. 436.

Fig. 5. *Deshayesites topleyi*, sp. n. Lower Aptian, *deshayesi*-zone, Atherfield, Isle of Wight. (L.F.S. no. 834.) P. 430.

Fig. 6. *Cheloniceras crassum*, sp. n. Aptian, Hythe Beds, Hythe. (Manchester Museum, no. L 11605.) P. 449.

PLATE XVI.

Fig. 1. *Parahoplites sussexensis*, sp. n. Upper Aptian, *subnodosocostatum*-zone. Pulborough, Sussex. (M.P.G. no. 46131.) P. 441.

Fig. 2. *Parahoplites* sp. juv. (*multicostatus* group). Upper Aptian, Sandrock Series ?, Isle of Wight. (M.P.G.) P. 442.

Figs. 3 *a*, *b*. *Deshayesites punfieldensis*, sp. n. Lower Aptian, *deshayesi*-zone, Atherfield, Isle of Wight. (M.P.G. no. 30915.) P. 431.

Figs. 4 *a–c*. *Dufrenoyia truncata*, sp. n. *a*, *b*. Inner whorls of a paratype and side-view of holotype (Manchester Museum. no. C 11606). *c*. Peripheral view of another example (M.P.G. no. 30920) from the Aptian, Hythe Beds, Hythe. P. 436.

Figs. 5 *a*, *b*. *Deshayesites vectensis*, sp. n. Aptian (Ferruginous Sands), Blackgang, Isle of Wight. (B.M. nos. C 889 *c*, *d*.) P. 430.

Fig. 6. *Cheloniceras perli*, sp. n. Lower Aptian, *deshayesi*-zone, Atherfield, Isle of Wight. (M.P.G. no. 31046.) P. 445.

Fig. 7. *Tonohamites proteus*, sp. n. Aptian, Hythe Beds, Lympne, Kent. (M.P.G. no. 32147.) P. 461.

PLATE XVII.

Fig. 1. *Deshayesites* aff. *grandis*, sp. n. Fragment, showing last two suture-lines, from the Aptian, *martini*-zone (bed V or VI), west of Whale Chine, Isle of Wight. (L.F.S. no. 717.) P. 427.

Figs. 2 *a*, *b*. *Deshayesites grandis*, sp. n. Aptian, upper *deshayesi*- or lower *martini*-zone, Atherfield, Isle of Wight. (M.P.G. no. 2300, Geol. Soc. Coll.) P. 427.

Fig. 3. *Tropæum* cf. *gigas* (Sowerby). Upper Aptian, *martini*-zone, Isle of Wight. (B.M. no. C 3671.) P. 458.

Fig. 4. *Procheloniceras* ? sp. ind. Plaster cast of an umbilical impression. Lower Aptian, Atherfield Clay, Isle of Wight. (L.F.S. no. 719.) P. 443.

Fig. 5. *Deshayesites* sp. (*consobrinoides-vectensis* group). Lower Aptian (bed III *b* = Upper Lobster Bed), Atherfield, Isle of Wight. (L.S.F. no. 720.) P. 431.

XLII.—*Exotic* Muscaridæ (*Diptera*).—XXIX. By J. R. MALLOCH, Bureau of Biological Survey, Washington, D.C.

Family Dosophilidæ.

Genus GITONIDES, Knab.

Gitonides perspicax, Knab.

A series of very well-marked specimens of this species from Weenen, Natal, March–April 1928 (*H. P. Thomasset*). No indication of circumstances of capture given.

Material returned to British Museum.

Family Conopidæ.

Genus STYLOGASTER, Macquart.

Stylogaster varifrons, sp. n.

Male.—Similar to *leonum*, Westwood, differing from it in having the frons with a large part of the central anterior half orange-yellow, the posterior third and the sides black, the vertex yellowish, and the frontal orbits sooty black. Thorax with the dorsum becoming brownish posteriorly, and without evident vittæ. Proboscis yellow at base, glossy black beyond except the apical slender processes. Legs not distinctly blackened, the hind femora slightly browned before middle, hind tarsi slightly darkened.

Frontal triangle broad, extending to anterior margin of frons, its anterior extremity broadly rounded ; orbital hairs almost lacking except above; third antennal segment about 1·25 as long as second on outer side, rounded at apex. Humeral bristle lacking; notopleurals two, placed vertically; a few microscopic hairs on scutellum besides the two strong apical bristles. Legs normal, the hind femora more distinctly attenuated than in *leonum*, fore femora not nearly as much thickened at bases as in that species, rather evenly narrowed from near base to apex ; mid-femora with the usual series of fine curved hairs on posterior side of apical half. In other respects as *leonum*.

Length 8 mm. (estimated ; abdomen missing in type).

Locality.—Umtali, S. Rhodesia, iv. 1929 (*A. Cuthbertson*).

In *leonum* the frons is orange-yellow, with a glossy black triangle to anterior margin, in *frontalia*, Krober, the entire frons is black.

Family Pyrgotidæ.

Genus Trichempodia, nov.

Generic Characters.—Belongs to the group in which the third wing vein is haired on the upper side, but the hairs extend almost to apex of the vein. Second antennal segment without a cleft; mid-coxal prong present but weak; ocelli lacking; face without a central carina, slightly convex centrally below; arista almost bare; each orbit with one bristle at upper extremity; vertex not sharp, all four vertical bristles present; postverticals present; proboscis short; palpi broad; prosternum setulose on sides; scutellum with four marginal bristles; dorsum of thorax with the following bristles: one humeral, two notopleurals, one presutural, one pair of acrostichals in front of scutellum and one pair of dorsocentrals distinctly proximad of them, one supra-alar, and two postalars; sternopleura, mesopleura, and pteropleura, each with one strong bristle; abdomen normal; femora without strong armature; empodium with fine hairs; anal cell of wing slightly angularly produced at lower posterior angle; auxiliary vein ending in costa at some distance before tip of first vein, not angularly bent; first vein setulose above, third setulose from base to near its apex above, bare below; costa extending to apex of fourth vein, the latter deflected, outer cross-vein very oblique, sixth vein complete.

Genotype, the following species.

Trichempodia cockerelli, sp. n.

Female.—Shining testaceous-yellow. Frons dull, except on the two short orbital stripes on upper portion and the ocellar triangle. Thoracic dorsum with six rudimentary fuscous vittæ, the central pair visible in front of suture, becoming obsolete behind it, the sublaterals present in front of and behind suture, but incomplete posteriorly, the lateral pair present only behind suture as short spot-like marks; mesopleural with a large dark central mark. Abdomen with the short tergites browned above. Legs entirely pale. Wings hyaline, with the following fuscous marks: a cloud over furcation of second and third veins extending to costa, an elongate mark over apex of first vein which extends over field to second vein, a rather shorter one on costa about midway between apices of first and second veins which extends over field to second, a longer one on costa from before apex of second vein to beyond its apex in which over [illegible] about its middle there is a hyaline wedge-shaped

incision, a cloud over the inner cross-vein, a spot on third vein just beyond level of upper extremity of outer cross-vein, a faint cloud at apex of wing, and another over outer cross-vein. Halteres yellow. All hairs and bristles black.

Frons at vertex about one-third of the head-width, gradually widened anteriorly, its length at centre about 1·5 as great as its width at vertex, surface with many rather strong black hairs; antennæ over half as long as face, second segment almost as long as third, the latter broadly rounded at apex, arista with microscopic black hairs on entire extent; eyes microscopically haired; cheek a little less than half as high as eye, with a brown central upper mark, and very minute marginal hairs. Thorax with the dorsal hairs moderately long and numerous, mesopleura with some long bristly hind-marginal hairs besides the single strong bristle. Abdominal tergites telescoped in type so that it is impossible to determine their comparative lengths, but the first visible one appears to be longest; sheath of ovipositor distinctly longer than hind tibia, cylindrical, slightly tapered on basal two-thirds, then rather abruptly attenuated, the apical third tapered to apex, with some long black hairs below, one on each side outstanding, the other surface-hairs quite numerous, but not very long. Legs rather slender, fore femur with a series of fine hair-like posteroventral bristles, hind femur with one anterodorsal bristle beyond middle; claws short. Inner cross-vein at a little over two-fifths from apex of discal cell, outer cross-vein at about its own length from inner.

Length 6·5 mm.

Type, Siam, top of Dai Satep, 5000 feet, 8. ii. 1928 (*Alice Mackie*). Sent to British Museum by Prof. T. D. A. Cockerell.

This genus is distinguished from its allies by the fringed empodium (a very exceptional character in the family), the mid-coxal prong, and the setulose third wing-vein.

Family **Ortalidæ**.

Subfamily *Platystominæ*.

Genus Sphenoprosopa, Loew.

In writing up some of my findings in this subfamily, I have had occasion to point out that it is very difficult for one to place the genera in their tribes by using Dr. Hendel's keys, and here we have another genus which, though placed by that authority in the same tribe as *Lamprogaster* and

others in which the lower calypter is much enlarged, appears to me to have closer affinities with Stenopterini, the general habitus being similar to that of many genera in this tribe and the lower calypter being quite small, hardly projecting beyond the upper one.

I give a summary of some of the generic characters not listed by Hendel and also the more salient of those distinguishing the genus from its allies.

Frons longer than wide, with many shining blackish spots on a grey-dusted ground and with numerous fine hairs, ocellar and postvertical bristles very short and fine, upper orbital hardly distinguishable, four verticals rather well developed; antennæ extending to mouth-margin, arista almost bare; face with the usual antennal foveæ rather deep, the central carina not sharp on sides. Thorax with at least one upper hind-marginal bristle on mesopleura, pteropleura haired; scutellum with only marginal bristles; prosternum with a few lateral hairs; sternopleural lacking; humeral present. Fourth visible tergite longest in male, shortest in female. Legs normal without ventral spines on femora. Anal cell distinctly shorter than second basal, without a lower posterior lobe; inner cross-vein at not over its own length from apex of discal cell; first posterior cell hardly narrowed at apex.

Sphenoprosopa fascipennis (Macquart).

Hendel was in error in stating that the abdomen lacks black dots except on the fourth visible tergite; all of them have such dots more or less numerous. The female has a number of quite prominent bristly hairs on each side of the second visible tergite near to the lateral curve at apex which are not present in the male. The black mark on the wing is less extensive in the male than in the female.

Locality.—Lorenço Marques, Portuguese East Africa.

Family Muscidæ.

Subfamily *Cœnosiinæ*.

Genus Anaphalantus, Loew.

Anaphalantus pennatus, Loew.

I have before me a female specimen of this species which shows a small fine pair of dorsocentrals in front of the usual two well-developed postsutural pairs, and, despite the fact that Stein states that the female has the fore tibiæ simple, it has the anteroventral and posteroventral surfaces of those

tibiæ furnished with quite dense stiff black hairs which, though much less conspicuous than the flattened scale-like hairs of the male, are still sufficiently characteristic to distinguish this sex also from any allied genus. The antennæ are very slender, extending to, or slightly below, the mouth-margin, the upper orbital bristle is recurved and very short, there is but one pair of distinct presutural dorsocentrals, and the stigmatal bristle is reduced to a microscopic hair. The bristling of the tibiæ is essentially the same as in the genus *Cœnosia*, Meigen, and the wing-venation is similar also, the sixth vein being abruptly discontinued near its base.

Locality.—Umtali, S. Rhodesia, ix. 1927 (*A. Cuthbertson*).

There is no indication on the label of the habits of the species.

In a previous article of this series of papers I have dealt with the synonymy of this species*.

Genus Stomopogon, nov.

This genus is distinguished from most genera in the subfamily by the presence of three anterodorsal and three posterodorsal bristles on the hind tibia, the apical one of each series the shortest. It is also readily distinguished from the genus *Lispocephala* and other genera that normally have two bristles on each of those surfaces by the presence of but one pair of backwardly directed orbitals on the upper portion of frons. In the genotype the vibrissal region is quite abundantly furnished with bristly hairs, the arista is pubescent, the ocellars long, the thorax and fore and mid tibiæ much as in typical species of *Cœnosia*.

Genotype, *Cœnosia albiseta*, Stein.

Habitat.—South America.

Subfamily *Phaoniinæ*.

Below I describe one new genus to enable me to include it in my generic key to the Muscidæ of the world, and also one new subgenus of *Dichætomyia*, Malloch, with a number of new species and records of the occurrence of others.

This last-mentioned genus is a very large one and contains several well-distinguished segregates, only one of which I am dealing with at this time. Unfortunately, practically nothing is known of the larval habits of the species either in Africa or the Orient, so that its economic importance cannot be determined at present.

* Ann. & Mag. Nat. Hist. (9) xiv. p. 274 (1924).

Genus Steinella, Malloch.

This genus has recently been redescribed by Shannon and Del Ponte as *Neurotrixa* in a paper published in the Argentine *. I have examined specimens of their species *mirata*, and find it is synonymous with the genotype, *prima*, Malloch.

Genus Limnophora, Robineau-Desvoidy.

There is rather a striking group of species belonging to this genus occurring in South America in which the thoracic dorsum is white-dusted, with three broad black vittæ extending over entire extent and to apex of scutellum; the abdomen black, seen from above with a median white-dusted vitta on the second and third visible tergites and sometimes also on first, and large lateral spots on second, third, and fourth tergites, the pair on last-mentioned sometimes yellow or golden brown. Structurally the species are very well distinguished in the males from other segregates, the frons being rather wide, with the triangle extending almost to anterior margin, and the arista is pubescent. I do not intend to give a revision of the group, but merely to record one of the species.

Limnophora femorata, Stein.

This species is distinguished from all the others by the possession of hairs on the sides of the scutellum below level of the marginal bristles, especially obvious at apex. The lateral spots on fourth tergite are white.

Locality.—Perales, Chile.

Genus Afromydæa, nov.

This genus superficially closely resembles *Idiopygus*, Malloch, the conspicuous black spots on the inner cross-vein and on each extremity of the outer cross-vein of the wing in the genotype reminding one strongly of that genus. However, it does not really run close to *Idiopygus* in the generic key which I have in preparation, the third wing vein being rather strongly setulose at base both above and below, and the abdomen more similar to that of *Hebecnema*, while the head is similar to that of some species of *Mydæa*, both the latter genera falling in the same caption in my key. The

* Revista del Inst. Bacter. No. 5, vol. iv. p. 29 (1926).

prosternum is bare, the sternopleurals 2+2, the genitalia of the female lacks strong bristles, the hind tibia has no postero-dorsal bristles, the hind coxæ are bare above the bases of femora, the mid-tibia lacks a ventral bristle, the fourth wing vein is not bent forward apically but rather deflected, the prealar bristle is short but distinct, and the eyes of the male are separated by less than one-fifth of the head-width. In most respects similar to *Mydæa*, differing in the lack of spines on the female genitalia, number of sternopleural bristles, conspicuously curved outer cross-vein of wing, and slight but evident deflection of the fourth vein at its apex.

Genotype, the following species.

Afromydæa punctatipennis, sp. n.

Male and Female.—Black, slightly shining, head, thorax, and abdomen with grey dust, mesonotum with four quite conspicuous black vittæ, the lateral pair broadest, abdomen with a pair of black spots on second and another on third visible tergite in both sexes, the fourth in male with traces of dark discal spot. Legs fuscous, fore pair in male yellow at knees, mid and hind pairs in same sex yellowish at middle of femora and broadly so on apices of tibiæ, in the female the femora and tibiæ except the apices of fore femora are yellow. Wings greyish hyaline, with deep black spots on inner cross-vein and each extremity of outer cross-vein. Calyptræ blackish in the male, white in female. Halteres with yellow knob in both sexes.

Eyes densely haired in male, much shorter and less densely haired in female; frons in male almost linear above, orbits with fine hairs above, becoming strongly bristled below; frons of female about one-third of the head-width at vertex, slightly widened anteriorly, each orbit with two backwardly curved bristles above, those in front of them incurved, only the anterior or lowermost one strong; ocellars long in both sexes; parafacials visible in profile, but not as wide as third antennal segment; arista long plumose to almost the tip; palpi normal; cheek a little higher than width of third antennal segment, haired on lower half, the upper hairs upcurved. Thorax with four pairs of postsutural dorso-centrals, two intra-alars, the prealar short but distinct, no hairs on sides of scutellum below level of the bristles; hypopleura bare. Abdomen rather broadly ovate in male, tapered at apex in female, both sexes with apical bristles on third and fourth visible tergites and discal bristles on fourth;

genitalia of female without spines; hypopygium of male not conspicuous. Fore tibia without a median posterior bristle; mid-tibia with two posterior bristles; hind femur with some bristles on apical half of anteroventral, and in the male at least with some less conspicuous bristles on basal half of posteroventral, surface; hind tibia with two anterodorsal and one anteroventral bristles. Costal thorn developed; outer cross-vein very distinctly bisinuate; setulæ at base of third vein extending about one-third of the distance from base to inner cross-vein; penultimate section of fourth vein about two-thirds as long as ultimate section in male, about three-fourths as long in female.

Length 7·5–8·5 mm.

Type, male, and allotype, mounted on same pin, Umtali, S. Rhodesia (*A. Cuthbertson*); paratypes, four females, with same data, iv. 1929. The type and allotype will be sent to the British Museum.

Though there is nothing on the label to indicate what the larval habits are, it is probable that this species occurs in manure or decaying vegetable matter, as the collector is at present working on the biology of species with this habit and the species was sent to me with material of similar habits.

Paratypes will be sent to the collector, and retained in my collection.

Genus Polietes, Rondani.

In Europe there have been usually three species assigned to this genus, but Ringdahl has recently removed one of these to another genus, referred to below. In doing so, he has confined *Polietes* to the species which have the prosternum haired on the sides, *lardaria*, Linné, being the genotype. Whether it is the only species I am unable to determine, as I lack the other one usually referred here.

From the new genus established by Ringdahl it may be distinguished by the presence of prosternal hairs, and also some fine hairs on the upper anterior angle of the hypopleura. In both genera the female has cruciate interfrontal bristles and two or more proclinate outer bristles on each orbit.

The genotype is Palæarctic.

Genus Pseudomorellia, Ringdahl.

A more slender genus than the above-mentioned one, and distinguished by the characters mentioned under same. It

is also very similar to *Pseudophaonia*, Malloch, a North American genus containing two species occurring in the northern states. In the European genus, however, the third wing vein is setulose at base above and below, while in the American genus this vein is bare. The single female of the genotype, *albolineata*, Fallén, which I have before me, has the posterior notopleural bristle duplicated, which is not the case in the American species, though, of course, it is possibly an abnormal specimen that I have. Both of these genera will run down to *Pseudophaonia* in my key published in 1923 *, but the lack of hairs on the third wing vein readily distinguishes the American genus from the European one, and, so far as I know at the present time, the one genus is Palæarctic and the other Nearctic.

It is rather unfortunate that the conspicuously white vittate dorsum of the thorax reminded the author of the genus so strongly of *Morellia* that he used the name as the basis for his new generic name, *Morellia* belonging to the Muscinæ and *Pseudomorellia* to the Phaoniinæ.

Genus Dichætomyia, Malloch.

Subgenus Macroxanthomyia, nov.

This subgenus is readily distinguished from the others by the presence of some setulæ or stiff hairs on the small knob-like protuberance on upper portion of the pleura immediately below the base of the wing and between the upper hind portion of the mesopleura and the upper anterior portion of the pteropleura. There are similar hairs in several other genera of Muscoidea, including the genus *Orthellia*, R.-D., and some genera of Chrysomyiinæ (Calliphoridæ). It is possible that this character may yet be considered as of generic importance, but in the meantime it is sufficient to give it subgeneric value, I believe.

I have seen no species of the subgenus from outside of the Ethiopean region, but there are quite a number of species known to me from there. The species which I place here are not so uniform in characters as are those of some other segregates of *Dichætomyia*, especially those occurring in the Orient, and I present below a key for the recognition of those now available to me.

Subgenotype, *Dichætomyia distanti*, Malloch.

* Trans. Amer. Ent. Soc. vol. xlviii. p. 231.

Key to the Species.

1. Thorax with four pairs of postsutural dorsocentral bristles; mesonotum with two narrow black vittæ along the lines of dorsocentrals which are overlaid with dense white dust; hypopleura with some microscopic black hairs on the central portion just below the spiracle and some on lower posterior angle .... *albivitta* (Stein).
   Thorax with three pairs of postsutural dorsocentral bristles, and without vittæ as described above .... 2.
2. Fore tibia with a submedian posterior bristle . 3.
   Fore tibia without a submedian posterior bristle .... 7.
3. Sides of the scutellum bare below level of the marginal bristles; palpi yellow.......... 4.
   Sides of the scutellum with numerous black setulose hairs below the level of marginal bristles, especially anteriorly .... 5.
4. Dorsum of thorax with a rather broad dark median vitta which is not sharply margined, and is widened posteriorly; hind femur of male with some fine bristly hairs at apex on posteroventral surface which are much shorter than the preapical anteroventral bristles .... *unilineata* (Stein).
   Dorsum of thorax without a dark median vitta, entirely fulvous-yellow, with rather noticeable whitish dust on three broad stripes or vittæ, which are most clearly evident when seen from behind; posteroventral surface of hind femur in male with some long fine bristles on apical fourth which are mostly longer than the preapical anteroventral bristles .... *distanti*, Malloch.
5. Some black hairs or setulæ below the lower calypter on postnotum; wings hyaline; abdomen with black apical fasciæ on apical two or three visible tergites; hind femur of female without distinct posteroventral bristles .... *obscuritarsis*, sp. n.
   No black hairs or setulæ below lower calypter............................ 6.
6. Hind femur in neither sex with more than one weak bristle on basal half of the posteroventral surface; wings usually quite distinctly infuscated, especially costally, most noticeably so at stigma............ *celosia*, sp. n.
   Hind femur in both sexes with several rather widely spaced outstanding bristles on basal half or more of the posteroventral surface; wings not at all infuscated.............. *fasciventris*, sp. n.
7. Sides of scutellum bare below level of the strong marginal bristles.................. 8.
   Sides of scutellum haired to lowest level, at [illegible]ly.......................... 9.

8. Abdomen and scutellum entirely yellow....	*immaculiventris*, sp. n.
Abdomen with deep black anterior fasciæ on the second to fourth visible tergites which are more or less distinctly interrupted centrally; scutellum with a dark mark on disc	*maculiventris*, sp. n.
9. Male with short and rather stout bristles on apical third or more of posteroventral surface of hind femur; female with black discal marks on third and fourth visible abdominal tergites	*ovata* (Stein) (?).
Male without short stout bristles on apical half of posteroventral surface of hind femur; female without black marks on dorsum of abdomen	sp.?

Dichætomyia (*Macroxanthomyia*) *albivitta* (Stein).

In addition to the characters mentioned in the foregoing key, the female of this species has two large black marks on the abdomen, one on third and the other on fourth visible tergite, the fore tibia has a bristle beyond middle on the anterodorsal surface, there are no hairs below the lower calypter, the sides of the scutellum are haired to lowest level, the frons at vertex is not one-fourth of the head-width, and there are some bristles on the basal half of the posteroventral surface of hind femur. As in the other species of this subgenus, there are some microscopic hairs in the hollow underside of the basal section of the stem-vein of the wing.

Length 8–9 mm.

Localities.—Bafodea, Sierra Leone, 13. iv. 1912 (*J. J. Simpson*); Embu, Kenya Colony, 30. xii. 1912, 8 P.M., 4700 ft. (*G. St. J. Orde Browne*); Moshi, Tanganyika Territory, 3. v. 1916 (*W. A. Lamborn*).

This species was described from the female alone, and this is the only sex I have seen.

There is a species closely resembling this one in thoracic characters etc. which does not belong to the same subgenus, lacking as it does the hairs on the pleural knob. It has the frons considerably wider and brownish dusted in the female, and the abdomen lacks black marks. I describe it on a subsequent page in this paper as *macfiei*, sp. n.

Dichætomyia (*Macroxanthomyia*) *distanti*, Malloch.

This species and the next one are very similar in most characters, but typical examples are readily distinguished by the characters listed in the key. There is a form of *unilineata* in which dark dorsal vitta is not present on the thorax, and in such specimens the hind femoral bristling of the male and the difference in the black markings of

abdomen are of value in separating the species. In *distanti* there is always a clear margin to the black marks on disc of third and fourth visible tergites, while in *unilineata* the dark marks, when present, are gradually tapered off on the sides and in front.

Localities.—Pretoria, Durban, Capetown, and Uganda.

Dichætomyia (*Macroxanthomyia*) *unilineata* (Stein).

Quite similar to the preceding species, but distinguishable by the characters listed in the key. In both these species the infrasquamal hairs are rather variable, in some cases even lacking, and in all specimens where present they are much lower placed than usual in this genus.

Localities.—Weenen, Natal; Florence Bay, Lake Nyasa; Zomba, Nyasaland; Umbilo, Natal; Tana River, Kenya Colony; and Mauokota, Uganda.

Dichætomyia (*Macroxanthomyia*) *obscuritarsis*, sp. n.

Female.—Shining testaceous-yellow, frons black, orbits narrowly white-dusted; occiput and cheeks black; antennæ testaceous-yellow, third segment largely darkened; palpi fuscous. Thorax with no trace of white dorsal dusting in type-specimen; prosternal hairs black. Abdomen with a dark apical fascia on each tergite from second to fourth visible inclusive, widened from second to fourth, broadest in centre. Legs yellow, tarsi fuscous. Wings yellowish hyaline.

Frons at vertex about one-fourth of the head-width, slightly widened in front; palpi slightly widened. Thorax normal, with some black hairs on postnotum close up against base of lower calypter; sides of scutellum haired to lowest level. Fore tibia with a posterior submedian bristle. Wings normal. Third visible tergite with the apical series of bristles incomplete centrally, discal bristles lacking on fourth, but the apical series complete and moderately strong.

Length 8 mm.

Type, Oshogbo, S. Nigeria, xi. 1910 (*T. F. G. Mayer*). A second specimen in poor condition which may be the same species, from Kampala, Uganda, 13. xi. 1917 (*C. C. Gowdey*).

Dichætomyia (*Macroxanthomyia*) *fasciventris*, sp. n.

Male and Female.—Very similar to the next preceding species in general colour and structure, differing in lacking the infrasquamal hairs, in having some quite well-developed bristles on a large portion of the posteroventral surface

of the hind femur, and usually more numerous bristles on the third and fourth visible tergites of the abdomen. There are two males of this species before me which differ from the female in having the antennæ entirely pale yellow, the palpi narrower, and the discal series of bristles on fourth tergite of abdomen complete and prominent. The extensive series of bristles on the posteroventral surface of the hind femur in both sexes is a good distinguishing character for this species. The frons of the male is linear for a considerable length medially.

Length 7·5–8·5 mm.

Type, male, allotype, and one male paratype, Oshogbo, S. Nigeria, xi. 1910, and 1–13. x. 1910 (*T. F. G. Mayer*); paratype females, S. Nigeria, iv. 1911 (*W. A. Lamborn*); and Ilesha, S. Nigeria, 23. vii. 1910, on house (*L. E. H. Humfrey*).

Dichætomyia (*Macroxanthomyia*) *celosia*, sp. n.

Male and Female.—Typical form: similar to the next preceding species in colour except that the dark mark on dorsum of abdomen covers all of dorsal exposure of fourth tergite, nearly all of that of third, and the central apical portion of second; the wings are browned or infuscated, especially along the costa, and most distinctly so at the stigma. Structurally the two species are quite similar, but the hind femur in both sexes has the anteroventral series of bristles much reduced, usually distinct only preapically, and there are no developed bristles on the posteroventral surface. The other structural characters are very similar.

Variety *dorsalis*: this variety differs from the typical form in having the dorsum of the thorax dark brown, almost fuscous, but in other respects it is almost the same as the typical form.

Length 8 mm.

Type, male, Umtali, S. Rhodesia, iv. 1929 (*A. Cuthbertson*), no. 2371; allotype, Oshogbo, S. Nigeria, 1–13. x. 1910 (*T. F. G. Mayer*); variety *dorsalis*, type, male, and one male paratype, Kampala, Uganda, 6. ix. 1918 (*C. C. Gowdey*).

Material will be sent to British Museum.

Two specimens, a male and female, from Gazaland, Chirinda Forest (*Odendaal*), are apparently the typical form, but they are in poor condition for examination.

Dichætomyia (*Macroxanthomyia*) *immaculiventris*, sp. n.

Male and Female.—A shining testaceous-yellow species, with black occiput, frons, and cheeks, the thoracic dorsum

lightly white-dusted, the dust showing subvittate when viewed from behind, the abdomen without dark marks, legs yellow, apices of tarsi slightly darkened, and the wings yellowish hyaline.

Structurally similar to *unilineata*, but rather more slender, the tibia without a submedian posterior bristle; hind femur of male with a series of fine bristles on basal two-thirds of posteroventral surface; both sexes with discal bristles on the fourth visible abdominal tergite.

Length 7·8 mm.

Type, male, allotype, and one male paratype, Lorenço Marques, Portuguese East Africa, 30. iii. 1909 (*C. W. Howard*); one defective female evidently of this species, Bububu, Zanzibar, 27. xi. 1910, on cattle (*W. M. Aders*).

Dichætomyia (*Macroxanthomyia*) *maculiventris*, sp. n.

Female.—This species has much the same appearance and coloration as dark specimens of *celosia*, var. *dorsalis*, except that the wings are hyaline, and the abdominal markings are distinctly outlined, more resembling those of *fasciventris*. The palpi are yellow, the thoracic dorsum is largely browned or infuscated centrally to middle of the scutellum with overlying greyish-white dust on the mesonotum, which is vittate when seen from behind, the second, third, and fourth tergites each have a wide anterior fascia of black which is interrupted medially by a yellow line, and the legs are entirely yellow.

Structurally the species is similar to the preceding one, differing from it in the characters listed in the specific key.

Length 7·5 mm.

Type, Ulundi, Natal, 5000–6500 feet, ix. 1896 (*G. A. K. Marshall*); paratype, Willow Grange, Natal (*R. C. Wroughton*).

Dichætomyia (*Macroxanthomyia*) *ovata* (Stein).

I have several specimens of both sexes of a species before me which I take to be *ovata*, Stein. It is a larger species than any of the others already dealt with in the subgenus, with a conspicuous black central apical mark on the third visible tergite and a large black triangle on fourth in both sexes. The thoracic dorsum has three rather evident white vittæ, the median one most evident presuturally, and the legs are entirely yellow, as are the palpi. The face is white even over the parafacials.

Structurally the species has been distinguished sufficiently in the key to enable anyone to identify it, but a comparison

with type-material is required to establish definitely the validity of my identification of the specimens as *ovata*.

Length 9·5–11 mm.

Localities.—Ufiomi, Tanganyika Territory, 2–6. vi. 1916, in well-watered valley (*W. A. Lamborn*); San Salvador, Portuguese Congo, Aug.–Oct. 1908 (*M. Gamble*); Gold Coast, 1910 (*W. P. Lowe*).

Dichætomyia (*Macroxanthomyia*) sp.?

A number of specimens including both sexes of a species which I am unable to identify specifically may not belong all to one species. I leave them aside in the meantime in the hope that some time later on I may be able to obtain further material to enable me to identify them definitely.

It may be of interest to note that one female of *fasciventris* (the allotype) has an egg protruding from the tip of the abdomen. This is fully 1·5 mm. in length, white in colour, and microscopically honeycombed on the entire surface. Its diameter is about one-fifth as great as its length, the general shape is somewhat boat-like with three or four shallow grooves along each side, and a flange projecting well above each side of the entire length which projects in the form of a rounded lobe for a short distance beyond the apex as exserted from the abdomen.

The oviparous habit is of interest, as some genera which are rather closely related, and occur in the New World (*Cyrtoneurina* etc.), deposit quite large larvæ, possibly of the second stage.

Dichætomyia (*Dichætomyia*) *macfiei*, sp. n.

Female.—Testaceous-yellow, slightly shining. Occiput fuscous, frons concolorous, with yellow dusting which becomes whitish on lateral margins, face testaceous, densely white, almost silvery, dusted; antennæ and palpi testaceous-yellow; proboscis black. Thoracic dorsum with two narrow black vittæ along the lines of dorsocentrals much as in *albivitta*, Stein, which are overlaid with white dust on broader vittæ, the latter carried over sides of scutellum; the white vittæ most conspicuous when seen from behind, the black vittæ most evident from the side and in front. Abdomen without dark marks. Legs testaceous-yellow. Wings yellowish hyaline.

Frons at vertex nearly one-third of the head-width, widened in front, bristling normal; palpi slightly widened, setulose. Thorax with four pairs of postsutural dorsocentral bristles,

the anterior pair shorter than the others; pleural knob bare, a blackish mark below it; hypopleura with some microscopic hairs in centre above and on lower posterior angle; sides of scutellum haired to lowest level. Abdomen ovate, with apical bristles on third and fourth visible tergites and on disc of fourth. Fore tibia without a submedian posterior bristle; hind femur without posteroventral bristles. Inner cross-vein of wing slightly proximad of middle of discal cell, the three outer sections of fourth vein almost equal in length, the ultimate one much shorter than usual in the genus.

Length 9 mm.

Type, Apata, Ilorin Province, N. Nigeria, 1912 (*J. W. Scott Macfie*).

Named in honour of the collector Dr. J. W. Scott Macfie, who a number of years ago submitted some material to me from Nigeria, and whose work on Nematocerous Diptera of this region is well known to students of the order.

Specimen returned to British Museum.

The rather peculiar brownish-yellow dusting of the frons of this species should prove a ready means of identifying the female, but the male is unknown to me.

Subfamily *Muscinæ*.

Genus Sarcopromusca, Townsend.

This genus was recently erected by Townsend for the reception of a species which appears to be widely distributed in South America, at least in mountainous sections. It is most closely related to *Orthellia*, Robineau-Desvoidy, but the genotype has much the appearance of a *Morellia*.

Sarcopromusca arcuata, Townsend.

This species is the only one known to me. I have seen it from Guatemala and Argentina, the latter being represented by specimens labelled *Orthellia pruna*, Shannon & Del Ponte, which is a synonym of *arcuata*. It may be readily identified by the rufous fourth visible abdominal tergite with its yellow dust. In this character the species is quite similar in appearance to some species of *Sarcophaga* occurring in the same general regions and to a South American species of *Graphomyia*.

It would appear possible that Townsend had this similarity in mind when he named the genus, and one is reminded by the same token of the fact that the genus-name *Promusca*,

Townsend, was given as a substitute for *Musca* by that author when he published his finding that *Musca* is properly applied to *Calliphora* if one accepts the law of priority as invariably applicable.

Family Calliphoridæ.

Subfamily *Sarcophaginæ*.

Genus Sarcophaga, Meigen.

In Part XXIV. of this series of papers I dealt with a few species of this genus, including some of those recently described by Bezzi from the Pacific Islands. I did not have at that time access to any examples of *rhynchura*, Bezzi, or *cirrhura*, Bezzi, so could not refer to them directly. I have now before me an example of *rhynchura*, and I present below some notes on the species and some others occurring in the same region.

Fig. 1.

Sarcophaga rhynchura, Bezzi.

Hypopygium of male from the side (*a*), and apex of penis from below (*b*).

Sarcophaga rhynchura, Bezzi.

This species and *cirrhura* have, according to Buxton, numerous hairs on the propleura, which character distinguishes them from the four species with yellow wing-bases dealt with in my paper referred to above. Neither have the wing-bases yellow, but in *rhynchura* the wings are distinctly browned or infuscated basally, in the example now before me rather evenly darkened from near apex to base, but not conspicuously so. This species has the supra-spiracular convexity without distinct hairs, the ocellar

bristles in male almost undeveloped, the parafacials with a few very fine pale hairs below middle (not bare, as Bezzi states), the mid-tibia with some rather dense black hairs on apical third or more which are not very conspicuous, and no strong ventral bristle, the mid-femur without long hairs and with short bristles on about the apical halves of anteroventral and posteroventral surfaces, the latter not comb-like as in many other species ; the hind femur much as mid-femur ; hind tibia with fine ventral hairs, those on the posteroventral surface very much longer than the others, and no strong anteroventral bristle. I rather incline to the opinion that Bezzi was in error in stating that the claws of the fore tarsi are truncate. He used almost exclusively a low-power lens in his work, and as most of the specimens with long claws usually have the apices broken off I believe that in his examples this had happened and he assumed that they were truncate. The hind trochanters of the male are furnished with a dense clump of short black spinules below. I figure some details of the hypopygium of the male (fig. 1).

Locality.—Salailula, Savaii, Samoa.

Sarcophaga peltata, Aldrich.

I am convinced that this species is distinct from the one occurring in Tahiti and identical with the North American form, from an examination of specimens submitted by Mr. P. A. Buxton that were taken in Samoa. I had previously expressed some doubt as to the identification of the Samoan species as *peltata*.

Sarcophaga froggatti, Taylor.

This species is not the same as *knabi*, Parker, and, so far as my material is concerned, does not occur outside of Australia. Specimens from New South Wales all have the centre of the propleura with quite long erect pale hairs which are never present in *knabi*, of which I have examined many examples, including the types.

Sarcophaga knabi, Parker.

This is undoubtedly the same as *omega*, Johnson & Teigs, as determined by Dr. Aldrich for Professor Johnston some years ago. That author and Hardy, in the paper on Australian *Sarcophaga* species in 1923 *, rejected Aldrich's identification because Parker's drawing of the hypopygium of his species did not agree with that of specimens of *omega*.

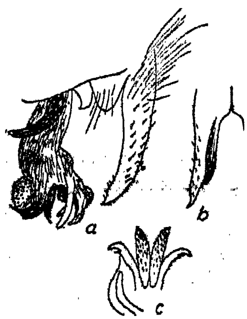
* Proc. Linn. Soc. N.S.W. vol. xlvii, pt. 2, p. 117.

Unfortunately, different artists and those who attempt to delineate such intricate organs do not always see the same structures in the same manner, and their depiction of them frequently varies in sufficient degree to justify one in having doubts as to their having pictured the same species. I have before me Philippine examples and some from Samoa, and these are in close agreement with the figures given by Johnston and Hardy, so that there can be no doubt as to the specific identity of the specimens involved.

Sarcophaga fuscicauda, Boettcher.

There is a very great similarity between examples of this species before me and the Australian species accepted by Johnston and Hardy as *peregrina*, Robineau-Desvoidy, which similarity extends to the male hypopygium, but I cannot

Fig. 2.



Sarcophaga fuscicauda, Boettcher.

Hypopygium of male from side (*a*), one superior forceps from behind (*b*), and part of apex of penis from below (*c*).

discover some of the details figured by these authors in the penis of the male which I have dissected. I figure the latter herein (fig. 2), and a comparison of the figures with those of *peregrina* given by the above-mentioned authors will show the differences. It may be worth mention that Dr. Aldrich has the same doubts as to the specific distinction of *fuscicauda* and *peregrina* as identified by the Australian authors.

One character which can be depended upon to separate *fuscicauda* from *knabi* and a number of rather similar appearing species is the presence of fine hairs on the centre of the propleura in the former. In the specimen of which I figure the hypopygium there are no outstanding fine hairs on the hind tibia, but in another which appears to agree very

well with it, but from Samoa, the hind tibia has some fine hairs on most of the extent of the posteroventral surface which are hardly longer than the tibial diameter. It will be noted that the superior forceps as figured have many little sharp spines on their outer halves, a character mentioned as variable by Senior-White, but which is merely variable in degree according to my material.

Before me there is one male from Malaya with record as below.

Perak, Telok Anson, 20. ii. 1929, "*ex* decaying unopened leaflets of *Cocos nucifera*," No. 5846 (*G. H. Corbett*).

Sarcophaga orientaloides, Senior-White.

Both this species and *orientalis*, Parker, have the abdominal sternites in the males quite densely covered with fine decumbent black hairs, and the hypopygia are of the same general type. They may, however, be readily distinguished by the hairing of the legs, and the mid and hind tibiæ being very densely long-haired ventrally in *orientalis*, and only the hind pair rather densely haired ventrally in *orientaloides*. I hope to be able to deal at more length with these and other Oriental species of the genus in a paper on the species of the Federated Malay States now nearing completion.

I have before me one male of *orientaloides* with data as below.

Federated Malay States, Cameron's Highlands, 2. iv. 1927, "parasite of Noctuid 3787," No. 3788 (*G. H. Corbett*).

It is rather doubtful if this is a true parasite, as it has been reared from a great many different pabula, including dead and decaying insects, decaying flesh, and night soil, etc.

XLVIII.—*Descriptions of new African Moths in the British Museum Collection*. By W. H. T. Tams.

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[Plate XVIII.]

Arctiidæ.

Lithosiinæ.

Genus Boadicea, nov.

Proboscis well developed. Palpus porrect, not reaching beyond frons. Antenna of male filiform with sparse fine

short setæ. Fore tibia with a sharply edged waved ridge on proximal two-thirds in front, outwardly directed. Fore wing moderately broad; veins *Sc* and *R* 1 free; *R* 2 + *R* 3 stalked, *R* 4 + *R* 5 stalked, *R* 3 anastomosing with *R* 4 to form areole; *M* 1 from upper angle, *M* 2 and *M* 3 from lower angle of cell; *Cu* 1 from just before angle, *Cu* 2 from just beyond middle of cell. Hind wing with *Sc* from cell well before middle; *Rs* and *M* 1 shortly stalked; *M* 2 + *M* 3 stalked for half their length; *Cu* 1 and *Cu* 2 arising as in fore wing.

Type of genus: *Boadicea pelecoides*, Tams, sp. n.

Boadicea pelecoides, sp. n. (Pl. XVIII. fig. 1.)

♂. Palpus and head (except fuscous occiput) ochraceous orange. Antenna light buff. Patagium ochraceous orange. Tegula fuscous, narrowly margined with ochraceous orange. Rest of thorax ochraceous orange. Abdomen (tergum) fuscous, narrowly tipped distally with ochraceous orange. Pectus, venter, and legs ochraceous orange, fore legs shaded with fuscous. Fore wing ochraceous orange, margined with fuscous (margin 1–2 mm. wide) from costa at two-thirds to tornus, where it is widest; a fuscous wedge-shaped patch (point basad) from wing-base to just beyond end of cell, enclosing an oval spot of ochraceous orange at end of cell. Hind wing ochraceous orange, margined with fuscous from apex to anal angle. Underside similar to upperside.

Holotype ♂: French Congo, Popos (*R. P. Ménager*).

Arctiinæ.

Diacrisia habrotima, sp. n. (Pl. XVIII. fig. 2.)

♂. Palpus bone brown outwardly, light buff inwardly. Antenna bone brown. Head light to warm buff. Thorax warm buff, tegula tinged on inner edge with bone brown. Abdomen (tergum) ochraceous orange, with a lateral series of bone brown spots. Pectus light buff, bone brown in front. Venter light buff. Legs light to warm buff, femora tinged with scarlet distally, fore tibia strongly shaded with bone brown, mid and hind tibiæ slightly so. Fore wing light buff, the veins shown up by cinnamon to drab shading on each side of them. Hind wing cartridge buff, fringe light buff. Underside of both wings cartridge buff, costæ and fringes light buff. Expanse 32 mm.

♀. Similar. Expanse 42 mm.

Holotype ♂: Kenya Colony, Nyeri, 6000 feet, 20. vii. 1922 (*W. J. Hughes*).

Allotype ♀: Uganda, Kigezi, ii. 1928 (*G. H. D. Carpenter*).

Hypsinæ.

Phægorista enarges, sp. n. (Pl. XVIII. fig. 9.)

♀. Palpus fuscous black, 2nd segment narrowly apricot orange ventrally. Antenna fuscous black. Head fuscous black, with some light buff at middle of frons, and some white posteriorly. Thorax fuscous black with white spots. Abdomen (tergum) apricot orange, each segment proximally fuscous black. Pectus apricot orange. Venter like tergum. Legs fuscous black dorsally, apricot orange ventrally. Fore wing apricot orange, black, and white; black at wing-base, with a prominent white spot below costa; costa narrowly black to middle, inner margin narrowly black to near tornus, leaving proximal half of wing apricot orange, the distal edge of which is almost straight from middle of costa to near tornus, where there is a curious hook-like extension of the apricot orange; rest of wing black, with a large white oval oblique patch (10 mm. long by 5 mm. wide) from just below costa to vein *Cu* 2; five small white spots on veins *M* 1 to *Cu* 2, before the termen; fringe white from apex to vein *M* 2, black to vein *Cu* 1, chequered to tornus. Hind wing apricot orange, with black margin 3 mm. broad, becoming narrower towards anal angle; fringe white with narrow black interrupting streaks interneurally. Underside of both wings similar to upperside, except that the fore wing lacks the black patch and white spot at base, and the five spots on the veins towards the termen.

Expanse 62 mm.

Holotype ♀: Kenya Colony, Rabai, June 1928 (*Dr. van Someren*).

Noctuidæ.

Hadeninæ.

Diaphone pyrsonota, sp. n. (Pl. XVIII. fig. 6.)

♂. Palpus warm buff banded with avellaneous. Antenna avellaneous. Head with frons avellaneous, vertex ochraceous orange. Thorax pinkish buff, tegula tinged with pallid neutral grey, anterior and posterior mesonotal tufts orange. Abdomen (tergum) warm buff tinged with clay colour, each segment edged distally with fuscous to clove brown. Pectus deep mouse grey to mouse grey. Legs: femur mouse grey, distal fifth warm buff; tibia warm buff tinged with ochraceous orange, with two bands of fuscous to fuscous black; tarsus [illegible] fuscous black, 1st segment warm buff at each end.

Venter warm buff tinged with clay colour, each segment edged distally with fuscous to clove brown. Fore wing light mouse grey; an outwardly oblique straw yellow to buff yellow subbasal fascia from costa to anal vein, edged proximally with rich black, with a slight dash of the straw yellow basad along the anal vein; an almost straight straw yellow to buff yellow antemedial fascia, oblique from costa at about one-third to just before middle of inner margin, $2\frac{1}{2}$ mm. broad, edged distally with a narrow, rich black, slightly waved fascia, bowed (convexity basad) in the cell; a large reniform stigma, straw yellow to buff yellow, edged, except costad, with rich black; postmedial fascia waved, straw yellow to buff yellow, $2–2\frac{1}{2}$ mm. wide, edged proximad with a rich black fascia, outwardly oblique from costa to vein *M* 1, then inwardly oblique (slightly crenulate) to vein *Cu* 1, where it touches the reniform stigma, thence bowed to inner margin at three-fourths; costa between antemedial and postmedial fasciæ tinged with straw yellow; fringe buff yellow. Hind wing semihyaline, white tinged with cartridge buff towards termen and inner margin; fringe straw yellow. Underside: fore wing cartridge buff tinged in the cell and beyond the postmedial fascia with avellaneous, the pattern of the upperside showing through; hind wing as on upperside, but tinged with cartridge buff along costa. Expanse 61 mm.

Holotype ♂: German East Africa, Bumbuli, November 19 (*S. G. Meinhof*).

Paratype ♂: Kenya Colony, Usambara, 1916 (*T. J. Anderson*).

CUCULLIINÆ.

Ectochela dasophrys, sp. n. (Pl. XVIII. fig. 3.)

♂. Palpus white to cartridge buff, streaked with fuscous black. Antenna white at base, distal five-sixths fuscous. Head and thorax white to cartridge buff, with fuscous black sparsely intermixed, tegula with a broad streak of fuscous black near its inner edge. Abdomen (tergum) cartridge buff sparsely irrorated with fuscous. Pectus white to cartridge buff, with fuscous sparsely intermixed. Venter cartridge buff sparsely irrorated with fuscous. Legs white to cartridge buff, irrorated and streaked with fuscous to fuscous black, distal three-fourths of each tarsus fuscous black. Fore wing white, tinged with light buff below lower margin of cell and at bases and tips of veins, with a delicate irroration of drab grey, except in cell; a fine rich black line along upper

margin of cell, continued, after a break at discocellulars, as a more pronounced interneural streak between veins *M* 1 and *M* 2 ; a prominent rich black streak along lower margin of cell, with short projections along veins *M* 3, *Cu* 1, and *Cu* 2 ; traces of black edging on each side of anal vein in middle two-fourths ; from just beyond end of cell to termen fine black interneural streaks, terminally expanded into dots ; an ill-defined diffuse subterminal shade from termen just below apex to middle of vein *M* 2, thence parallel with termen to inner margin ; fringe fuscous, chequered with white at vein-ends. Hind wing white tinged with cartridge buff, distal third suffused, except just at apex and anal angle, with fuscous ; a tinge of fuscous on discocellulars and post-medially on medial and cubital veins ; a terminal series of interneural fuscous black dots edged with cartridge buff ; fringe white. Underside : both wings cartridge buff ; fore wing with drab irroration on costa and subterminally, with traces of interneural fuscous streaks and terminal dots ; hind wing underside similar to upperside ; sparse fuscous costal irroration ; fuscous discocellular streak more pronounced. Expanse 35 mm.

Holotype ♂ and paratype ♂ : Cape Province, Matjesfontein, 1–18. xii. 1928 (*R. E. Turner*).

Another paratype ♂ from the same place is dated 1–6. xi. 1928.

Ectochela turneri, sp. n. (Pl. XVIII. fig. 7.)

♂. Palpus cartridge buff, fuscous and fuscous black mixed. Antenna fuscous black streaked with cartridge buff. Head with frons light buff mixed with fuscous black. Thorax white and cartridge buff mixed with fuscous black, tegula edged inwardly with fuscous black. Abdomen (tergum) cartridge buff to light buff, irrorated with fuscous. Pectus cartridge buff, streaked in front with fuscous. Venter cartridge buff irrorated with fuscous. Legs white, cartridge buff and fuscous black mixed. Fore wing white to cartridge buff, mixed with drab, costa streaked with fuscous black ; a fuscous black streak along vein *Sc* from wing-base to middle of cell ; upper edge of cell finely fuscous black, lower edge of cell broadly so ; a longitudinal fuscous black streak within the cell ; heavy fuscous black shading on the discocellulars ; an oval cartridge buff spot outlined with fuscous black, between the bases of veins *M* 3 and *Cu* 1 ; a similar spot, larger, between the bases of veins *Cu* 1 and *Cu* 2 ; longitudinal interneural fuscous black streaks from cell to termen, more pronounced distally ; a diffuse fuscous subterminal shade

from vein *R* 5, gradually decreasing to vein *Cu* 1; inner margin fuscous black; fringe fuscous to fuscous black divided by fine white streaks at vein-ends. Hind wing cartridge buff; an indistinct fuscous dash on discocellulars, between veins *M* 2 and *M* 3; some diffuse drab to fuscous subterminal shading; four fuscous black interneural dots between veins *M* 1 and *Cu* 2, with some further fuscous black shading on termen towards anal angle. Underside fore wing cartridge buff, irrorated with fuscous black along costa, and with drab over the distal third; long cartridge buff to drab hair-scales in the cell; a prominent fuscous black spot on discocellulars; fuscous black interneural terminal dots; underside hind wing cartridge buff, sparsely irrorated with fuscous black from base to termen between costa and upper margin of cell + vein *M* 1, with a few scattered scales below vein *M* 1 towards termen; fuscous black streak along discocellulars; fuscous black dots interneurally on termen; fringe with some fuscous black scales along its base. Expanse 42 mm.

Holotype ♂: Cape Province, Matjesfontein, 1–6. xi. 1928 (*R. E. Turner*).

Acronyctinæ.

Chiripha orestera, sp. n. (Pl. XVIII. fig. 8.)

♂. Palpus blackish brown mixed with Brussels brown, the 2nd segment with some long russet hair-scales in front, some cartridge buff at base and more at apex encircling the 3rd segment, which is tipped with cartridge buff. Antennal shaft drab mixed with fuscous, the long pectinations buffy brown. Patagium in front broadly cartridge buff mixed with drab and vinaceous russet, narrowly margined behind with fuscous black mixed with Prout's brown; tegula cartridge buff mixed with vinaceous russet through the middle, edged with fuscous black mixed with Prout's brown; rest of thorax cartridge buff mixed with drab and vinaceous russet medially, edged laterally with fuscous black. Abdomen (tergum) cartridge buff to light buff mixed with fuscous, with some long vinaceous russet hair-scales over basal half; anal tuft cinnamon buff. Pectus cartridge buff, fuscous mixed with vinaceous russet to ochre red in front. Venter fuscous mixed with vinaceous russet and cartridge buff. Legs fuscous irrorated with cartridge buff and vinaceous russet; fore tibia and tarsus broadly cartridge buff in front. Fore wing rich velvety clove brown, broken up into a variety of small patches by streaks of cartridge buff; between costa and cell, and along costa, various patches of clove brown alternating

with cartridge buff tinged with vinaceous, including a short, sharply-defined, oblique (terminad) cartridge buff subbasal streak, surrounded by some tawny or cinnamon irroration; veins mostly fuscous; cell with its velvety clove brown filling edged with tawny to cinnamon; orbicular stigma narrow, sharply outlined in cartridge buff and filled in with tawny or cinnamon (its lower extremity open), sharply oblique at the same angle as vein *Cu* 2; reniform stigma similar but slightly larger and roughly parallel with termen; a small cartridge buff spot between veins *R* 4 and *R* 5 subterminally; a sharply oblique streak between veins *R* 5 and *M* 1, with signs of continuation just beyond the latter vein; commencing at lower margin of cell about 3 mm. from wing-base a subbasal cartridge buff streak sharply oblique basad; from just beyond origin of subbasal streak a similar antemedial streak, less sharply oblique outwardly towards inner margin, but not reaching anal vein; from origin of antemedial streak a gradually widening cartridge buff patch extending just beyond vein *Cu* 2, in its centre an oval velvety clove brown spot with some tawny scaling below it; from just before middle of vein *Cu* 2 a cartridge buff streak directed for a short distance towards a point just beyond middle of inner margin, but turning basad before reaching the anal vein, towards which it gradually converges after remaining parallel for about 2 mm., its colour grading from cartridge buff at the bend through tawny to Prout's brown; from the bend in this fascia sometimes an extension runs tornad; some Prout's brown on each side of anal vein; below anal vein a bowed (concavity costad) cartridge buff streak nearly to middle of anal vein, on which its extremities lie; inner margin cartridge buff tinged with tawny; from the junction of vein *M* 3 with cell a bowed (concavity costad) cartridge buff streak touching vein *M* 2 and reaching the terminal fascia; a similar streak (concavity costad) arising before middle of vein *Cu* 2, and joining the terminal fascia at vein *Cu* 1; these two streaks joined at the terminal fascia by a cartridge buff sagittate mark directed basad; terminal fascia cartridge buff, conspicuous, edged distally with clove brown; fringe clove brown, with streaks of cartridge buff tinged with vinaceous buff at the vein-ends, with a cinnamon buff line through its base, and a cartridge buff line through its middle. Hind wing white tinged with cartridge buff along costa and inner margin; a fuscous discocellular spot; some irregular fuscous shading before termen, which is also edged with fuscous; proximal half of fringe light buff, separated from the white distal half by a fuscous line. Underside fore wing white suffused with fuscous except along inner

margin beyond postmedial fascia, where there is a marked vinaceous suffusion; orbicular and reniform stigmata, the patch below juncton of *Cu* 2 with cell, and some of the subterminal marks, indicated by a lack of irroration; a fuscous streak on discocellulars; distinct traces of a diffuse fuscous postmedial fascia; hind wing underside similar to upperside, but with spot on discocellulars more prominent, and traces of a postmedial series of streaks on the veins and some fuscous irroration along costa. Expanse 40 mm.

♀. Similar, but with a distinct but diffuse postmedial fascia on hind wings, and much heavier subterminal shading. Antennæ not pectinate. Expanse 40 mm.

Holotype ♂ and allotype ♀: Kenya Colony, Aberdare Range, January–February 1928 (*G. W. Glazebrook*).

Syncalama turneri, sp. n. (Pl. XVIII. fig. 4.)

♀. Palpus, antenna, head, and thorax fuscous black mixed with cartridge buff to light buff. Abdomen (tergum) warm buff mixed with fuscous. Pectus, venter, and legs cartridge buff mixed with fuscous, tarsi banded with fuscous. Fore wing fuscous black mixed with white, producing a *dark grey* effect; antemedial fascia and orbicular and reniform stigmata not sharply defined; a well-marked postmedial fascia parallel with termen to just below vein *Cu* 2, thence to inner margin at right angles; a series of fuscous black subterminal streaks on the veins, with a terminal series of fuscous black lunules interneurally; fringe fuscous. Hind wing white, with sparse fuscous irroration before the fuscous black termen; fringe white with a faint fuscous line through its middle. Underside: fore wing white tinged with cartridge buff, suffused with fuscous, fuscous black along costa, and with a terminal series of fuscous black lunules interneurally; hind wing white, costal and terminal margins broadly but sparsely irrorated with fuscous; a terminal series of fuscous black lunules interneurally. Expanse 30 mm.

Holotype ♀: South-west Africa, Okahandja, 19–29. iii. 1928 (*R. E. Turner*).

Euterpiodes blepta, sp. n. (Pl. XVIII. fig. 5.)

♀. Palpus blackish brown. Antenna honey yellow with some cartridge buff scales at base. Head blackish brown, the frons snuff brown laterally. Thorax cartridge buff, blackish brown mixed with sepia and snuff brown in front. Abdomen (tergum) cartridge buff, patchily shaded with fuscous. Pectus cartridge buff, fuscous in front. Venter cartridge buff, banded with fuscous. Legs cartridge buff

shaded with fuscous to blackish brown. Fore wing cartridge buff; rich blackish brown shading along costa, with violet slate shading through cell and towards apex; antemedial fascia not traceable from costa to lower margin of cell, thence consisting of three arcs, those at cell and inner margin velvety blackish brown (concavity basad), the middle arc violet slate (concavity terminad), the ends of the latter overlapping the adjacent ends of the other two arcs; an ocellate orbicular stigma just beyond middle of cell, violet slate centrally, ringed with cartridge buff, the latter outlined with velvety blackish brown; reniform stigma similar, but elongate, extending across end of cell; a velvety blackish brown postmedial fascia, bowed (convexity terminad) from costa to vein *Cu* 2, thence slightly bowed (concavity terminad) to inner margin at three-fourths, consisting of an interrupted line preceded by velvety blackish brown shading, narrow from costa to vein *M* 1, forming a spot between veins *M* 1 and *M* 2, narrow again to vein *Cu* 1, thence broad and prominent to inner margin; some subterminal violet slate patches, a large one (previously mentioned) at apex between costa and vein *M* 2, a smaller patch between veins *M* 3 and *Cu* 1, and a larger patch before tornus; fringe fuscous, some irregular cartridge buff edging interneurally. Hind wing cartridge buff with some irregularly distributed sparse fuscous irroration in distal third; fringe cartridge buff. Underside fore wing cartridge buff, broadly suffused with fuscous except for a patch of unshaded ground-colour between cell and inner margin; underside hind wing cartridge buff sparsely irrorated along costa and in distal third with fuscous, with a fuscous streak on discocellulars. Expanse 25 mm.

Holotype ♀: Gold Coast, Northern Territories, Kete Krachi, 1925 (*A. W. Cardinall*).

Westermanniinæ.

Earias ansorgei, sp. n.

♂. Palpus white, mixed with dull Indian purple. Antenna drab to fuscous, some vinaceous purple at base. Head marguerite yellow tinged with Cosse green. Thorax Cosse green. Abdomen (tergum) light buff tinged with drab, with a small, flat, Cosse green crest at base. Pectus white to marguerite yellow. Venter marguerite yellow, segments edged with light buff. Legs marguerite yellow, the fore leg dorsally and outwardly dull Indian purple, the mid leg with a trace of dull Indian purple at the femoro-tibial joint. Fore

wing Cosse green, immaculate. Hind wing cartridge buff, immaculate. Underside of fore wing light dull green yellow, of hind wing cartridge buff, both immaculate. Expanse 18–20 mm.

Holotype and 3 paratype ♂♂: North Angola, N'Dalla Tando, 2700 feet (*W. C. Ansorge*), dated 2. xi. 1908, 5. xi. 1908, 15. xi. 1908, and 2. xii. 1908.

EXPLANATION OF PLATE XVIII.

Fig. 1. *Boadicea pelecoïdes*, Tams, sp. n., ♂.
Fig. 2. *Diacrisia habrotima*, Tams, sp. n., ♂.
Fig. 3. *Ectochela dasophrys*, Tams, sp. n., ♂.
Fig. 4. *Syncalama turneri*, Tams, sp. n., ♀.
Fig. 5. *Euterpiodes blepta*, Tams, sp. n., ♀.
Fig. 6. *Diaphone pyrsonota*, Tams, sp. n., ♂.
Fig. 7. *Ectochela turneri*. Tams, sp. n., ♂.
Fig. 8. *Chiripha orestera*, Tams, sp. n., ♂.
Fig. 9. *Phægorista enarges*, Tams, sp. n., ♀.

XLIX.—*Further Studies on the Dermaptera and Orthoptera of Manchuria.* By. G. Bey-Bienko.

The present paper is a second contribution of the author on the Orthopteroid insects of Manchuria †; it is based on a collection made during 1927 by members of the Manchurian Research Society, Harbin, and sent to the author for determination.

In this contribution about one hundred specimens are recorded, representing thirty-eight species and races, of which one belongs to the Dermaptera, one to the family Blattidæ of the order Orthoptera, also one to the family Mandidæ, eight to the family Tettigoniidæ, two to the family Gryllidæ, and twenty-four to the family Acrididæ. Species not yet recorded from Manchuria are marked with an asterisk.

Order DERMAPTERA.

Family Forficulidæ.

*1. *Timomenes komarovi* (Sem.).—Hingan, 24.vii., 1 ♂.

This species was described by A. P. Semenov-Tian-Shansky from N. Korea under the name *Opisthocosmia*

† Bey-Bienko, G., "Studies on the Dermaptera and Orthoptera of Manchuria," 'Konowia,' Bd. viii. 1929, pp. 97–110, figs. 1–3.

komarovi †; since its description the species has not been recorded from any other country.

Order ORTHOPTERA.

Family Blattidæ.

*2. *Cryptocercus* sp. (*spadicus*, Shiraki ?).—Gaolindzsy, 22–27.viii.1926, 1 ♂, 1 ♀; same locality, vi.1926, 2 ♂♂, and 2 larvæ.

This interesting genus and species was recorded by me from Manchuria (*loc. cit.* p. 98) without a distinct name, because at that time I had no literature for the determination of this strange insect. Recently I have received an excellent monograph of North American Blattidæ by Morgan Hebard ‡, in which I have found a species, viz., *Cryptocercus punctulatus*, Scudder, from the subfamily Panesthinæ, which is unquestionably congeneric with my Manchurian specimens (Hebard, *loc. cit.* pp. 255–258, pl. x. figs. 13–16); in the footnote 395 of this monograph (p. 255), the author writes that the second species of the genus *Cryptocercus*, Scudder, i. e., *C. spadicus*, was described by Shiraki (Annot. Zool. Jap. vi. 1906, p. 32, pl. ii. fig. 2) from Gifu, Japan. Although I have not seen the paper by Shiraki, it is very probable that Manchurian specimens of the genus *Cryptocercus* belong to Japanese *C. spadicus*, because some species of Orthoptera known from Japan were found in Manchuria or in adjacent countries as Korea or Russian Far East (for instance, *Conocephalus japonicus*, Redt., *C. chinensis*, Redt., *Metrioptera bonneti*, Bol., *Euprepocnemis shirakii*, Bol., and others).

After a comparison of the very complete description and good figures of *C. punctulatus* given by M. Hebard with the Manchurian specimens, I have found the following differences:—Body much smaller. Anterior femora with 2–5 spines on anterior lower margin, and with 2–3 spines on posterior lower margin; all other femora without spines, or the middle femora with only one spine on anterior lower margin. Maxillary palpi as in *C. punctulatus*, but distal truncation of the fourth joint equals only half the length of

† Semenov, A., "The First Paleanarctic Species of the Genus *Opisthocosmia*, Dohrn," Revue Russe d'Ent. i. 1901, pp. 98–100, figs.

‡ Hebard, M., "The Blattidæ of North America, North of the Mexican Boundary," Mem. Amer. Ent. Soc. n. 2, 1917, pp. 1–284, pls. i–x.

that joint. Longitudinal depression of the pronotum near its posterior end T-shaped; meso- and metanotum, as well as all abdominal tergites only very delicately punctured, even on lateral portions, without projections; sixth abdominal sternite of the female truncate on the apex, and with feeble, but distinct, rounded excisions on lateral margins before the apex; genitalia of male and female as well as the shape of the sixth abdominal sternite of the male sex as in *C. punctulatus*. Length of body, ♂ 17–21, ♀ 20, of pronotum, ♂ 5–5·6, ♀ 5·5; width of pronotum, ♂ 7–8, ♀ 7·8; length of hind femora, ♂ 3·7–4, ♀ 3·8 mm.

Family **Mantidæ.**

*3. *Mantis religiosa*, L.—Harbin, 10.ix., 1 ♂.

Known from China, Korea, and from the Russian Far East, but not yet recorded from Manchuria.

Family **Tettigoniidæ.**

*4. *Phaneroptera falcata* (Scop.).—Hingan, 5.viii.1927, 1 ♀; Gaolindzsy, 2 ♂ ♂.

*5. *Tettigonia cantans* (Fuessly).—Hingan, 17.viii., 1 ♂; Pogranitshnaya, 20.viii., 1 ♂.

*6. *Decticus verrucivorus* (L.).—Hingan, 14.viii., 2 ♀ ♀.

These three species are widely distributed in Palæarctic regions, but have not been recorded previously from Manchuria.

7. *Gampsocleis sedakowi sedakowi* (F.-W.)—Hingan, 14.viii., 4 ♀ ♀; Pogranitshnaya, 20–22.viii., 2 ♀ ♀.

Recorded from Mukden by Dirsh †.

8. *Gampsocleis sedakowi obscura* (Walk.).—Pogranitschnaya, 20–22.viii., 1 ♂, 2 ♀ ♀.

It is interesting that these two subspecies were taken at the same locality.

† Dirsh, V., "Studies on the Genus *Gampsocleis*, Fieb.," Mém. de la Classe d. Sciences Phys. et Math. d. l'Acad. d. Scienc. d. l'Ukraine, vii. 1927, p. 151.

*9. *Metrioptera bonneti* (Bol.).—Hingan, 13.ix., 1 ♂ ; Boring, 5–6.viii., 1 ♀.

This Japanese species was recorded recently by Uvarov from the Russian Far East † and, therefore, its occurrence in Manchuria is not unexpected.

*10. *M. bicolor* (Phil.).—Hingan, 14.viii., 2 ♀ ♀.

11. *Deracantha onos*, Pall.—Dalai-nor, 30.viii., 1 ♂.

Recorded by me from the station Tshzhalantun (*loc. cit.* p. 99).

Family Gryllidæ.

12. *Gryllus infernalis*, Sauss.—Dalai-nor, 30.viii., 1 ♀ ; Gaolindzsy, x., 1 ♂, 1 ♀.

13. *Gryllotalpa africana*, Pal. Beav.—Harbin, 2 ♂ ♂, 1 ♀ ; Boring, 5–6.viii., 1 ♀ ; Horhonte, 13.vii., 1 ♀.

Family Acrididæ.

14. *Parapleurus alliaceus* (Germ.).—Pogranitshnaya, 20.viii., 1 ♂.

15. *Eogeacris vittatus* (Uv.).—Hingan, 5.viii., 1 ♀.

Described by Uvarov from Transbaicalia and Manchuria ‡, and known at present from some other localities.

16. *Mongolotettix ussuriensis* (Ikonn.).—Hingan, 14.viii., 1 ♀.

The genera *Eogeacris* and *Mongolotettix* were erected recently by Rehn in his interesting paper § ; the former with *Chrysochraon brachypterus*, Ocsc., and the latter with *Ch. japonicus*, Bol., as their respective genotypes. Unfortunately, Rehn did not see all species of the group, for instance, specimens of *Podismopsis ussuriensis*, Ikonn., which differs distinctly from the genotypes of the genera *Mongolotettix* and *Eogeacris*, but has the ovipositor as in these two

† Uvarov, B., "Some Orthoptera from the Russian Far East," Ann. & Mag. Nat. Hist. ser. 9, xvii. 1926, p. 279.

‡ Uvarov, B., "Contribution à la faune de Orthoptères de la Province de Transbaicalie," Ann. Mus. Zool. Acad. Sci. St. Pétersb. 1914, p. 198.

§ Rehn, J., "On the Relationships of certain new or previously known Genera of the Acridinæ Group *Chrysochraontes*," Proc. Acad. Nat. Sci. Phila. lxxx. 1928, pp. 189–205, pl. xxii.–xxiii.

genera, therefore his key to genera included some features not of generic value. It is evident that *ussuriensis* is more closely related to *Mongolotettix* than to any other genus of the group, but only a more detailed study of the Palæarctic representatives of the group will show the relationship of all genera and species.

*17. *Chorthippus fallax* (Zub.).—Loshagou, 10.ix., 2 ♀♀.

*18. *Ch. longicornis* (Latr.).—Hingan, 4.viii., 1 ♂, 1 ♀.

*19. *Ch. intermedius* (B.-Bienko).—Hingan, 24.viii., 1 ♂.

These three species are widely distributed in Siberia and Mongolia, but have not been recorded from Manchuria.

*20. *Megaulacobothrus æthalinus* (Zub.).—Hingan, 4.viii., 1 ♂.

Caudell † recently described from the Russian Far East *M. kongausensis*, but this species was synonymised by me ‡ with *æthalinus*, Zub.; it is widely distributed in Siberia, but was not known from Manchuria.

21. *Arcyptera microptera sibirica*, Uv.—Horhonte, 13.viii., 1 ♂, 2 ♀♀.

22. *A. fusca fusca* (Pall.).—Hingan, 14.viii., 4 ♀♀; Pogranitshnaya, 20–22.viii., 1 ♂, 1 ♀.

23. *A. fuscus albogeniculata*, Ikonn.—Dalai-nor, 30.viii., 1 ♂; Hingan, 14.viii., 2 ♀♀; Pogranitshnaya, 20–22.viii., 1 ♀; Boring, 5–6.viii., 1 ♀.

24. *Gomphocerus sibiricus sibiricus* (L.).—Hingan, 14.viii., 1 ♀.

*25. *G. rufus* (L.).—Hingan, 4.viii., 1 ♂.

First record for Manchuria.

† Caudell, A., "Orthopteroid Insects from the Maritime Province of Siberia," Proc. U.S. Nat. Mus. lxxi. n. 7, p. 3.

‡ Bey-Bienko, G., "Beiträge zur Kenntnis der Verbreitung der Orthopteren in Asiatischen Russland," Zool. Anzeig. Bd. lxxxi. 1929, pp. 69–70.

26. *G. przewalskii*, Zub.—Mangan, 12.viii.1926, 1 ♀.

This badly preserved specimen was recorded by me from Manchuria under the name "*Chorthippus* sp." (*loc. cit.* p. 101, n. 22), but a careful comparison with good specimens of *G. przewalskii* shows that it belongs to this species.

*27. *Aiolopus chinensis*, Karny.—Mangan, 12.viii.1926, 2 ♂♂, 2 ♀♀, and larvæ; Anda, 15–16.viii.1926, 1 larva.

This species was recorded by me in my previous paper on the Orthoptera of Manchuria under the name *A. tergestinus* (loc. cit. p. 102, n. 31).

28. *Psophus stridulus* (L.).—Hingan, 14.viii., 1 ♂; Boring, 5–6.viii., 1 ♀.

29. *Bryodema tuberculatum dilutum* (Stoll).—Dalai-nor, 7.vii., 1 ♂, 2 ♀♀; Hingan, 14.viii., 1 ♂, 1 ♀.

30. *B. luctuosum luctuosum* (Stoll).—Dalai-nor, 7.vii., 1 ♂, 2 ♀♀.

*31. *B. holdereri holdereri*, Krauss.—Horhonte, 13.vii., 1 ♂.

32. *Angaracris barabensis* (Pall.).—Dalai-nor, 30.viii., 1 ♂; Hingan, 14.viii., 2 ♂♂; Horhonte, 13.vii., 5 ♂♂, 6 ♀♀.

33. *A. rhodopa* (F.-W.)—Horhonte, 13.vii., 1 ♂, 1 ♀.

The genus *Angaracris* was erected by me for these two species in my monograph of the genus *Bryodema*, Fieb., and its allies (in print).

34. *Celes skalozubovi skalozubovi*, Adel.—Dalai-nor, 30.viii., 1 ♂; Boring, 5–6.viii., 1 ♀.

*35. *Locusta migratoria migratoria*, L.—Loshagou, 10.ix., 1 ♂.

Predtetshensky recently shows in his excellent study † that Palæarctic Migratory Locust is divided into two subspecies, viz., *L. migratoria migratoria*, occurring in more southern zones, and *L. migratoria danica*, L., differing from the former in somewhat smaller size, and occurring in

† Predtetshensky, S. A., "*Locusta migratoria*, L., in Central Russia," Reports Bureau of Appl. Entom. iii. n. 2, pp. 113–199.

Northern Europe. Both these subspecies have solitary and migratory phases (*sensu* Uvarov); the former was called by Predtetshensky (*loc. cit.* p. 182) ph. *solitaria*, and the latter ph. *accumulata*, Plotnikov.

Our specimen belongs to the *Ph. accumulata*, i.e., to the swarming and migratory phase, but has reddish hind tibiæ.

It appears that the tropical Migratory Locust also belongs to a distinct subspecies, the swarming phase of which was called *migratorioides*, Rch. & Frm., while the solitary phase (ph. *danica*, sensu Uvarov) is similar to that in subsp. *migratoria*, L.

Uvarov, in his classical handbook on injurious locusts and grasshoppers †, remarked that "it is not definitely known which swarming phase (more exactly subspecies, B.-B.) of the Migratory Locust occurs in China and Formosa; apparently in the latter country it is *migratorioides*, and in China *migratoria*." As our specimens from Manchuria belong to the swarming phase of the subsp. *migratoria*, we see that Uvarov's conclusion is quite correct, at least for North China. At the same time Rehn's record of *Pachytylus migratorius*, L., from Korea ‡, is also quite correct, and unquesrionably refers to the swarming phase of the subsp. *migratoria*.

36. *Podisma frigida* (Bok.).—Hingan, 28.vii., 1 ♀ (f. *macroptera*); same locality, 14.viii., 1 ♂, 2 ♀♀.

This is probably the first record of f. *macroptera* for this species.

37. *Prumna primnoa* (F.-W.).—Hingan, 14.viii., 3 ♀♀; Pogranitshnaya, 20–22.viii., 2 ♂♂, 3 ♀♀.

*38. *Eirenephilus debilis*, Ikonn.—Gaolindzsy, 13.ix., 5 ♂♂, 4 ♀♀.

This species is widely distributed from Altai in Siberia to the Russian Far East, North Mongolia, and Korea, but not recorded previously from Manchuria.

The following 26 species of the Dermaptera and Orthoptera, not treated in this study, were recorded for Manchuria by

† Uvarov, B. P., 'Locusts and Grasshoppers.' London, 1928, pp. 1–352, pl. i.–ix. figs.

‡ Rehn, J. A. G., "Contribution toward a Knowledge of the Orthoptera of Japan and Korea.—I. Acrididæ," Proc. Acad. Nat. Sci. Phila. 1902, p. 634.

different authors, myself included (see my first study) :—*Forficula vicaria*, Sem., *F. robusta*, Sem., *Blattela germanica*, L., *Conocephalus chinensis*, Redt., *Homorocoryphus nitidulus*, Scop., *Gampsocleis inflata*, Uv., *Œcanthus longicaudus*, Mats., *Acrida turrita*, L., *Chorthippus apricarius*, L., *Ch. hammarstrœmi*, Mir., *Ch. dubius*, Zub., *Ch. bicolor*, Charp., *Ch. albomarginatus*, Deg., *Ch. dorsatus*, Zett. (subsp.?), *Euchorthippus unicolor*, Ikonn., *Œdaleus infernalis*, Sauss., *Sphingonotus mongolicus*, Sauss., *Haplootropis brunneriana*, Sauss., *Oxya adentata*, Will., *O. manzhurica*, B.-Bienko, *Podisma parvula*, Ikonn., *Calliptamus abbreviatus sibiricus*, Unuk., *Euprepocnemis shirakii*, Bol., *Acrydium sibiricum*, Bol., *A. subulatum*, L., and *A. longulum*, Shiraki (?).

Thus, at the present time, we know from Manchuria 64 species and races, out of which three belong to the order Dermaptera, two to the family Blattidæ of the order Orthoptera, one to the family Mantidæ, eleven to the family Tettigoniidæ, three to the family Gryllidæ, and forty-four to the family Acrididæ.

This number is small for Manchuria, situated in a very interesting and rich part of Palæarctic region, and I think that the complete fauna of the country will include more than one hundred species of Dermaptera and Orthoptera.

L.—*The Structure of* Branchiosaurus flagrifer, *sp. n., and Further Notes on* Branchiosaurus amblystomus, *Credner*. By W. F. Whittard, Ph.D., D.I.C., A.R.C.S.

[Plates XIX. & XX.]

A few years ago Professor D. M. S. Watson acquired a collection of Branchiosaurs from Gottlob, near Friedrichroda (Thuringia) *, and it was found that the material from this new locality did not correspond with any described species of *Branchiosaurus*, although it was most closely allied to *B. amblystomus*, Credner. Later, the authorities of the British Museum (Nat. Hist.) obtained a further collection, and these two collections have furnished the specimens upon which the description of the new species has been framed. Additional information has been obtained of the structure of certain of the cranial bones of *Branchiosaurus amblystomus*, and this is incorporated here as a supplement to the detailed account published in 1926 †.

* The collection is housed in the Zoology Dept., University College, [illegible]

† [illegible] pp. 537–549 (1926).

Sub-phylum **AMPHIBIA.**

Order PHYLLOSPONDYLI, Credner.

Family **Branchiosauridæ**, Fritsch.

Genus BRANCHIOSAURUS, Fritsch.

Branchiosaurus flagrifer, sp. n.*

Holotype. Specimen no. 4, Collection D. M. S. Watson, University College, London.

Locality. Gottlob, near Friedrichroda, Thuringia.

Horizon. Godlauterer Schichten, Rotliegende, Permian.

The material examined includes fifteen specimens. The bones are present as extremely thin laminæ, and in many specimens the body-impression is preserved, the original skin being now represented by a carbonaceous film.

(i.) *The Skeleton.*

(a) *The Skull.*

The form is salamandrine, the skull attaining its greatest breadth in the region of the quadrates, and gently tapering anteriorly. The measurements of the skull of a larva are: breadth 10 mm., length 8·6 mm., and the height at the dermo-supraoccipitals about 3·0 mm. The bones of the cranial roof are nearly completely preserved, but no specimen shows sufficient of the palatal elements to allow a reconstruction to be made.

The Cranial Roof. (Fig. 1.)

Piercing the bones of the top of the head are the paired foramina of the eyes and nares and the unpaired elliptical foramen of the middle or pineal eye. The orbits are large in proportion to the size of the cranium, and they occur just at the position of the turnover from the table-like top of the skull to the downward curving side. Contained within the orbit is the sclerotic ring consisting of thirty-two plates. The nares are placed well to the front and side of the head.

Parietals. In association, these bony plates are helmet-like in appearance, and along their admesian border they are pierced by the parietal foramen which has a length of 1·1 mm. The supratemporal elements form deep re-entrants into the sides of the parietals, while anteriorly and posteriorly the parietals effect simple sutural contacts with the frontals and dermo-supraoccipitals.

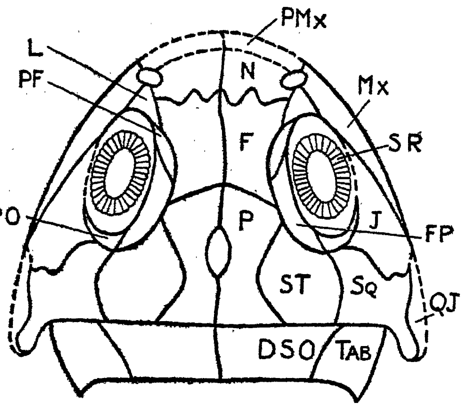
* *flagrifer* = bearing a whip: referring to the whip-like tail.

Frontals. Elongated subrectangular bones limited laterally by the lachrymals, prefrontals, and postfrontals; anteriorly they form an undulose suture with the nasals.

Nasals. Laterally the nasals bound the inner margin of the oval nares, and anteriorly they make an overlapping contact with the premaxillæ.

Dermo-supraoccipitals. The hinder part of the skull is delimited from that situated more anteriorly by the straight suture of the combined supraoccipital and tabular bones, an arrangement peculiarly characteristic of the Branchiosaurs in general. The dermo-supraoccipital is about twice as broad as long.

Fig. 1.



Reconstruction of the cranial roof of *Branchiosaurus flagrifer*, sp. n. Based on Spec. no. 4, Coll. D. M. S. W. × $5\frac{3}{4}$ approx.

DSO, dermo-supraoccipital; F, frontal; FP, postfrontal; J, jugal; L, lachrymal; Mx, maxilla; N, nasal; P, parietal; PF, prefrontal; PMx, premaxilla; PO, postorbital; QJ, quadrato-jugal; SQ, squamosal; SR, sclerotic ring; ST, supratemporal; TAB, tabular.

Tabulars. These bones typically show the prolongation of the postero-lateral corner, although no facet has been determined on the ventral side for the lodging of the end of the muscle replacing the posttemporal bone present in fishes. In association with the squamosal the tabular forms the otic notch, which is not deeply inset.

The circumorbital series is complete, and although the orbits are relatively large, yet the lachrymals are present as well-developed elements. The *prefrontal*, *postfrontal*, and *postorbital* form a bony ring round the inner and posterior

part of the orbital margin. The hook-shaped postorbital effects vertical sutural connection with the postfrontal, which overlaps the prefrontal, and is itself partly concealed medially by the attenuated side of the frontal. The *lachrymal* is a thick triangular bone which occupies the region between the orbit and the nares. The *jugal* is rarely preserved, and its shape has not been observed, but after assembling the surrounding bones the probable outline of the jugal is obtained.

Quadratojugals. The quadratojugal is not clearly outlined in any specimen, but it is certain that it occupies a position at the side of the squamosal, and does not extend very far forward, as it fails to reach the level of the hinder end of the orbits. The *Quadrates* have not been observed, and they were probably unossified.

Maxillæ. The margin of the skull between the naris and the quadratojugal is formed by the maxilla; this is the longest element in the cranial roof and extends downwards to the oral surface, where it carries a row of conical teeth. It sends upwards a projection, *processus frontalis*, which is overlain by the lachrymal; the maxilla is in contact along the inner side with the premaxilla, lachrymal, and jugal, and it is included in the margin of the orbit and the naris.

Premaxillæ. Although present in the majority of the specimens, these elements are seldom sufficiently well preserved to allow of their exact determination. They occupy the front of the cranium between the nares, and in certain cases where the premaxillæ have drifted apart there is an indication of a posteriorly directed shelf upon which rested the prevomer.

Supratemporals. Paired bony laminæ of characteristic shape, which invade the parietals and give rise to the typical helmet-like outline of these paired bones.

Squamosals. The squamosal is the thickest bone in the head, and consists of an upper surface and a downward projecting side which articulates with the quadratojugal. The otic notch is bordered laterally by the squamosal, which is coarsely ornamented, a character unpossessed to such a marked degree by its fellow members of the cranial roof.

None of the palatal bones are sufficiently well preserved to warrant description.

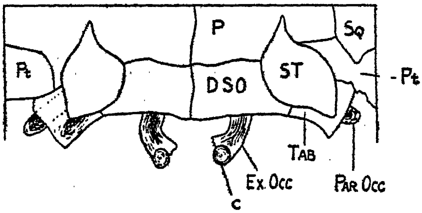
The Occiput. (Fig. 2.)

It is interesting to find that no mention has been made of the occipital bones in any previously described Branchiosaur, and it seems that our lack of knowledge of this region of the skull is due either to the elements being originally in the

cartilaginous state or to the poor preservation of individual specimens.

Exoccipitals. In nearly all the material examined the exoccipitals are a pair of elongated bones projecting from behind the skull. At the ventral termination of the exoccipital there is a circular smooth condyle, which is bounded dorsally by an inner prolongation carrying a serrated edge (fig. 2), and it was against this edge that the cartilaginous basioccipital abutted. The condyles are therefore separated paired structures, and they carry no foramen for the hypoglossal nerve. As preserved, the exoccipitals have the appearance of bony tubes which have collapsed medially, and this probably indicates that they were mainly composed of cartilage which was ossified only on the outside.

Fig. 2.



Drawing of the posterior end of the skull of *Branchiosaurus flagrifer*, sp. n., made from a plasticine squeeze. Spec. no. 4, Coll. D. M. S. W. × 5¾ approx.

C, exoccipital condyle; DSO, dermo-supraoccipital; Ex Occ, exoccipital; P, parietal; Par Occ, paroccipital; Pt, pterygoid; Sq, squamosal; ST, supratemporal; Tab, tabular.

Paroccipitals. A complete bone has not been seen, owing to the fact that the paroccipitals are invariably covered to a great extent by the tabulars, below which they can be followed by the ridge caused by the crushing of these bones upon them. The paroccipitals are thin long elements consisting of a bony sheath surrounding a cartilaginous core.

Although the bones of the occiput are so poorly ossified in the Phyllospondyli, sufficient is known of their disposition in *Branchiosaurus flagrifer* to show that in all probability a similar evolution occurred in the Branchiosaurs as has been postulated for the Labyrinthodonts *. Even in *B. flagrifer* the occiput is incompletely ossified, and nothing is known of the shapes of the supraoccipital and basioccipital. From the

* D. M. S. Watson, "The Structure, Evolution and Origin of the Amphibia: The 'Orders' Rachitomi and Stereospondyli," Phil. Trans. Roy. Soc. ser. B, vol. ccix. (1919); "The Evolution and Origin of the Amphibia," ibid. B, vol. ccxiv. (1926).

position usually occupied by the paraoccipital and exoccipital in crushed specimens of *B. flagrifer*, it seems evident that the occiput sloped backwards and downwards from underneath the dermo-supraoccipital bones of the cranial roof. In a paper on the Lower Coal Measure Branchiosaur *Eugyrinus wildi* (A. S. Woodward), Professor Watson writes as follows:—

"The skull of *Eugyrinus* .... shows that the general structure of the early Phyllospondylian skull is identical in essentials with that of the Labyrinthodonta. In comparison with *Branchiosaurus* it shows that the Phyllospondyli had a similar evolutionary history to that of the Labyrinthodonta carried through at a much earlier date, and of which only the latter half is known. As the latter parts of the stories of the two groups are similar, we are surely justified in expecting that the beginnings will resemble one another, and that we may take the primitive Labyrinthodonts as representing structurally the unknown ancestors of the Branchiosauria"*.

If, then, the primitive Labyrinthodonts are ancestral to the Branchiosaurs, the early Branchiosaurian genera must have possessed the vertically placed occipital region so characteristic of the Embolomerous Amphibia.

Professor Watson has shown that a series of evolutionary trends can be recognized in the Labyrinthodonts, and in the region of the occiput he finds in Triassic genera that,

(i.) the hypoglossal nerve (xii) no longer passes through the exoccipital;
(ii.) there is less ossification in the brain-case, and a loss of the basioccipital and supraoccipital elements, giving rise to a pair of well-separated exoccipital condyles;
(iii.) the occiput is no longer vertical, but slopes backward.

B. flagrifer possesses these same three characters as are typical of Triassic Labyrinthodonts; but, because *B. flagrifer* is a Permian species, it is becoming increasingly evident that evolution in the Branchiosauridæ was more rapid than in the Labyrinthodontia. A similar conclusion is suggested when other parts of the skeleton of Branchiosaurs are studied, but a more complete thesis of the evolution of the Phyllospondyli cannot be forthcoming until the structure is known in detail of the American genera *Eumicrerpeton*, *Mazonerpeton*, and *Micrerpeton*, which were described by Moodie †.

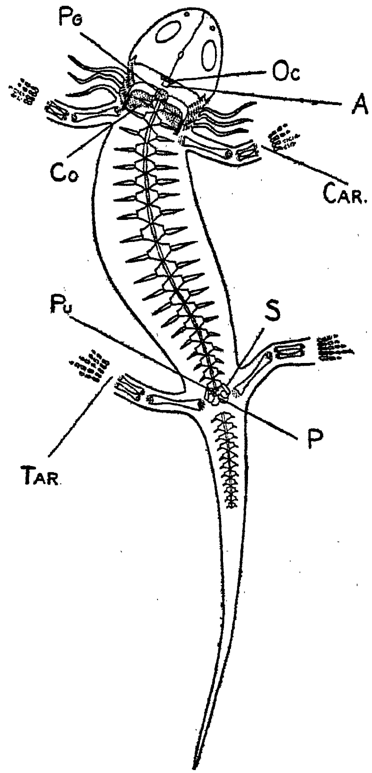
* Geol. Mag. vol. lviii. p. 73 (1921).

† R. L. Moodie, "The Coal Measures Amphibia of North America," Carnegie Institute Publications, pp. 51–66 (1916).

The External and Internal Gills. (Fig. 3.)

External gills were first described in *Branchiosaurus amblystomus*, and the presence of internal gills in several species of *Branchiosaurus* and *Pelosaurus* has been postulated on the occurrence in these forms of gill-rakers *. Both

Fig. 3.



Restoration of *Branchiosaurus flagrifer*, sp. n. Natural size. Restoration based upon Spec. R/5466, Coll. Brit. Mus. (Nat. Hist.). 1st vertebra diagrammatically represented; 2nd, 24th, 25th vertebræ omitted. Stippled areas indicate cartilage.

A, atlas; CAR., carpus; Co, coracoid; Oc, occiput; P, pelvis; PG, pectoral-girdle; PU, pubis; S, sacral rib; TAR, tarsus.

types of gills have now been determined in *B. flagrifer*, and, as in *B. amblystomus*, there are three long and slowly tapering external gills on each side of the neck. Each gill is a

* P. Z. S. pt. ii. pp. 543 & 571 (1926).

simple structure which shows no signs of pinnæ; although in the restoration of *B. amblystomus* these gills were inferred to be pinnate by analogy with modern Amphibia, it is now considered inadvisible to figure the pinnæ in the restoration of *B. flagrifer,* as their form is a matter of conjecture. It is sufficient to realize that the number of external gills in certain Branchiosaurs is the same as that characterizing the larval forms of many modern Amphibia.

The gill-rakers show the same disposition as already described in *B. amblystomus* and other species *. There were four loops, of which the first and fourth carried one row of rakers and the other two rows were armed with gill-rakers on either side. This arrangement suggests the presence of three gill-slits on each side of the neck.

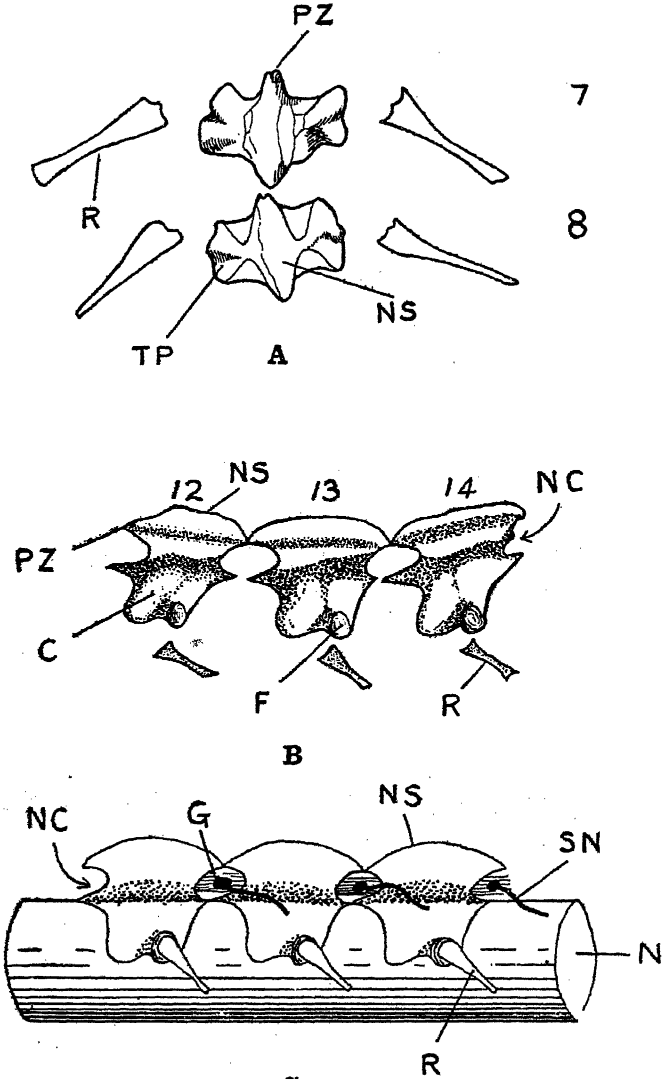
(b) *The Vertebral Column.* (Fig. 4.)

The extreme tenuity of the vertebræ and their poor preservation makes the determination of the detailed structure a matter of considerable difficulty, but it is certain that the component members of the vertebral column are of a peculiar type.

The *Atlas,* or first vertebra, is seldom seen; it appears to be an elongated bone connecting anteriorly by odontoid-like processes to the condyles on the exoccipital bones, and posteriorly effecting overlapping connection with the pre-zygapophysis of the second vertebra. There are 21 *thoracic vertebræ,* and these are of the same general type. An individual vertebra is composed of a pronounced neural spine which surrounds the cavity of the spinal cord and passes ventrally into the circumchordal region, which is prolonged laterally as two transverse processes (fig. 4, **A**). At the lower posterior corner of the circumchordal region there is a facet for the articulation of the rib (fig. 4, **B**). Ribs are present on all the vertebræ, and as the capitular process is missing each rib is single-headed. There is a suggestion in some vertebræ of pre-zygapophyses, and these necessarily imply the presence of post-zygapophyses. At the base of the neural spine the bone is prolonged forwards and backwards, and in association with the corresponding dorsal prolongations of the zygapophyses a posterior and anterior semicircular re-entrant is formed along the line of the neural canal. Thus between adjacent vertebræ there is a circular opening which may have lodged a nerve-ganglion, and from which may have originated a pair of spinal nerves, one on

* P. Z. S. pt. ii. p. 543 (1926).

Fig. 4.



Thoracic vertebræ of *Branchiosaurus flagrifer*, sp. n. **A.** 7th, 8th vertebræ viewed from the top. × 10 approx. Specimen no. R/5282. Coll. Brit. Mus. (Nat. Hist.). **B.** 12th, 13th, 14th vertebræ viewed from the left side. × 12 approx. Specimen no. R/5284. Coll. Brit. Mus. (Nat. Hist.). **C.** Schematic restoration showing the relation between the vertebræ and the notochord. × 12 approx.

C, circumchordal region; F, facet for articulation of rib; G, ganglion; N, notochord; NC, neural canal; NS, neural spine; PZ, prezygapophysis; R, rib; SN, spinal nerve; TP, transverse process.

either side of the vertebra. Such spinal nerves would have issued from behind their respective vertebra, and they would have been situated intravertebrally.

As indicated by the absence of centra, the circumchordal ossification did not continue ventrally, and it seems definite that the *notochord* was quite free from bone at its lower extremity. The vertebræ of *B. flagrifer*, the best-known of all Branchiosaurian vertebræ, thus belong to the epichordal type which is characterized by "an almost complete suppression of both basiventral and interventral elements, so that the chorda remains for a long time in the ventral surface of the vertebral column in the shape of a flattened longitudinal band" *. This condition of the vertebral column is not peculiar to *Branchiosaurus*, as a similar state is present in such Anura as *Bombinator*, *Pelobates*, and *Pipa*. A suggested relationship of the notochord to the vertebræ is shown in fig. 4, **C**.

The *sacral* vertebra, or twenty-third vertebra, carries two large ribs which are connected to the top of the inner side of the ilia, and thus ensure rigidity to the small pelvis (fig. 3).

There may be as many as 20 *caudal* vertebræ, but the number varies greatly. Haemal arches are present below the circumchordal region, and each vertebra carries a pair of ribs. The large number of postsacral vertebræ may be correlated with the possession of a long whip-like tail, which necessarily required a strong musculature for its movement. Such a musculature would have been intimately connected with the caudal vertebral column.

The details of the vertebral column given above have been obtained from two larval forms. With approach to maturity there may have been a more extensive ossification of the vertebræ, resulting in the complete encasement of the notochord, but the balance of the evidence from the Branchiosaurs in general shows that this did not occur.

(c) *The Appendicular Skeleton.*

An examination of the limbs and their supporting girdles in *B. flagrifer* shows the remarkable similarity of these structures to corresponding skeletal parts in *B. amblystomus*, and this in itself is sufficient to demonstrate the close relationship of the two species.

* H. Gadow, Phil. Trans. Roy. Soc. ser. B, vol. clxxxvii. p. 17 (1896).

Pectoral-girdle and fore-limbs.—The *interclavicle* was a membranous structure occupying a mid-ventral position, and was contained between the two *clavicles*; these bones extend outwards to the level of the posterior projection of the tabulars, then ascend in the body as thin rods, and finally attain connection with the backward directed cleithra. Each *cleithrum* rests upon the top anterior margin of a semi-lunar scapula. The *scapula* was underlain by an unossified *coracoid* carrying the glenoid cavity, into which fitted the humerus. The *humerus*, *radius*, and *ulna* are uncalcified at their extremities, and the wrist bones were cartilaginous. The *manus* consists of four digits, of which the phalangeal formula is probably 2232, each digit being terminated by a claw.

Pelvic-girdle and hind-limbs.—The pelvis, which is much smaller than the shoulder-girdle, is made rigid by its connection to the vertebral column through the sacral ribs, which are attached to the inner sides of the ilia. The *ilium* is a sturdy dumbbell-shaped bone, articulating at the hinder region of its lower extremity with the *ischium*, which is almost square in shape. No ossified *pubis* has been observed, but its cartilaginous equivalent was probably placed on the same level as the ischium just in front of that bone, and connected above with the anterior region of the ventral end of the ilium. Although the acetabulum is in all probability partly contained in the ischium and pubis, it is mainly lodged in the outer side and towards the lower end of the ilium. The *femur*, *tibia*, and *fibula* were cartilaginous terminally, and no indication of the arrangement of the cartilages of the tarsus is preserved. There are five digits in the *pes*; the phalangeal formula is probably 22343, each digit carrying a claw.

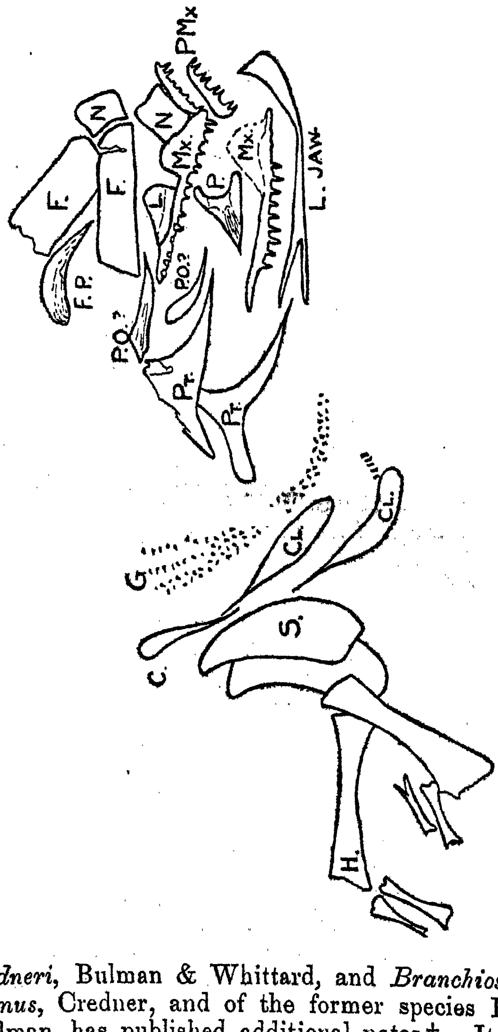
(ii.) *The Body Impression.*

The rock which contains the skeletons of *B. flagrifer* is a bluish-black clay-slate exhibiting a fine-grained texture. It seems evident that the sediment accumulated rapidly, and this led to the quick entombment of the dead animals. Putrefaction of the tissues must have been slow, because the preservation is so remarkably good that in many cases the impression of the body is visible as a carbonaceous film. *B. flagrifer* possessed a long, delicately proportioned tail which was whip-like in form, and in this character it shows a difference from other Branchiosaurs which are characterized by laterally compressed tails.

Branchiosaurus amblystomus, Credner, 1881 *.

The vertebrate collection in the Geologische-Palæontologische Institut of Tübingen University contains a large number of Branchiosaurs referable to *Micromelerpeton*

Fig. 5.



Right side view of the skull and shoulder-girdle of *Branchiosaurus amblystomus*, Credner. × $4\frac{1}{2}$ approx. Key to Pl. XX. C. Spec. 88, Geol.-Pal. Inst. Tübingen.

C, cleithrum; Cl., clavicle; F., frontal; F.P., postfrontal; G., gill-rakers; H., humerus; L., lachrymal; Mx., maxilla; N., na ; P., palatine; PMx., premaxilla; P.O.?, post-orbital; Pt., pterygoid; S., scapula.

credneri, Bulman & Whittard, and *Branchiosaurus amblystomus*, Credner, and of the former species Dr. O. M. B. Bulman has published additional notes †. It is the object

* For a revision of this species, see P. Z. S. pt. ii. p. 537 (1926).
† Ann. & Mag. Nat. Hist. ser. 10, vol. i. p. 250 (1928).

here to describe two elements of the cranial roof of *B. amblystomus* which were imperfectly known, and to add further details of the external gills of the same species.

Locality. Odernheim, Rheinpfalz.

Horizon. Lebacher Schichten, Upper Rotliegende, Permian.

One disarticulated skull preserved in side view shows admirably the outline of the maxilla and premaxilla (fig. 5). The *maxilla* is elongated, and on the internal anterior margin it expands to form the *processus frontalis*, which effects articulation with the ventral surface of the cranial roof; on the oral surface the maxilla carries about fourteen small conical teeth. The *premaxilla* is a small bone occupying a vertical position at the front of the snout, and carrying on its lower surface eight small conical teeth arranged in pairs.

In two specimens (62, 9) the three external gills on the left side are remarkably well preserved (Pl. XX), and it is apparent that they were of considerable length in proportion to the size of the animal. The longest gill measures 8·5 mm., when the skull is 8·0 mm. long. Specimen 62 also clearly demonstrates the position of the external gills in relation to the internal gills, the loops of which are indicated by the lines of gill-rakers.

My best thanks are due to Professor D. M. S. Watson, who has provided much of the material for investigation, and who has supervised my research. Professor Baron F. von Huene extended an invitation to Dr. O. M. B. Bulman and myself to study the Branchiosaur Collection at Tübingen University, and I wish to tender my appreciation of his help and assistance. Mr. J. R. Thomas has once again undertaken the photography. I also gratefully acknowledge the loan of several specimens from Tübingen University and from the British Museum (Nat. Hist.). The research has been carried out with assistance at first from the Department of Scientific and Industrial Research and later from the Commissioners for the Exhibition of 1851.

EXPLANATION OF THE PLATES.

Plate XIX.

A. Almost complete specimen of *Branchiosaurus flagrifer*, sp. n., showing body outline. Spec. no. R/5467, Coll. Brit. Mus. (Nat. Hist.). × 1·7.

B. Plasticine squeeze of the skull of *Branchiosaurus flagrifer*. Spec. no. 4, Coll. D. M. S. W. × 2·8.

B, body outline; C, clavicle; E, exoccipital; F, femur; H, humerus; S, scapula.

PLATE XX.

A. *Branchiosaurus amblystomus*, Credner. I, II, III, external gills; 2, 3, 4, second, third, fourth loops of the internal gills. No. 62, Geol.-Pal. Inst. Tübingen. × $2\frac{1}{2}$ approx.

B. Ditto, viewed from top, and showing three external gills (I, II, III) on the left side. No. 9, Geol.-Pal. Inst. Tübingen. × 2 approx.

C. Ditto. View of the right side of disarticulated skull and shoulder-girdle. For explanatory key, see fig. 5. No. 88, Geol.-Pal. Inst. Tübingen. × $2\frac{1}{4}$ approx.

LI.—*Upper Cretaceous (chiefly Campanian and Maestrichtian) Gastropoda and Pelecypoda from Palestine.* By

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[Plates XXI. & XXII.]

INTRODUCTION.

The following investigation is a continuation of my paper, "On Upper Cretaceous (chiefly Maestrichtian) Ammonoidea from Palestine" (Ann. & Mag. Nat. Hist. (10) iii. pp. 433–456, pls. ix., x.). The introduction to that paper contains a detailed geographical and geological description of the area in which the fossils have been collected. In short, the area is that part of the Jordan desert which lies between Wadi Kelt* in the north and Wadi Nar in the south. The strata are of Upper Cretaceous, chiefly Senonian age. In the middle part of the Senonian, fossils occur commonly, consequently most of our material belongs to the Campanian and Maestrichtian. Some Anisomyaria, however, have been collected from the Lower Senonian (=Santonian), whereas the Uppermost Senonian (=Danian) has yielded only one determinable specimen (*Pecten obrutus*).

The latter fossil, known from the bituminous Limestone of Nebi Musa, was also found at the base of the overlying mottled lime and gypseous marl-zone, but has not been recorded from the underlying Maestrichtian phosphate horizon. Blanckenhorn (1915) regards the beds with *P. obrutus* as of Danian age.

The independent position of the Maestrichtian, which has been pointed out as regards the ammonoid fauna (*Libyceras, Baculites*), may further be observed in the characteristic Maestrichtian gastropods such as *Turritella reyi* and

* The names of the localities are taken from the map of the Palestine Exploration Fund.

Scalaria desertorum. Less useful for stratigraphical purposes appears to be the Pelecypod fauna, for certain forms occur frequently in the Maestrichtian as well as in the Campanian.

The Campanian and Maestrichtian rocks are soft, more or less chalky, and very frequently intercalated with flint-layers. The passage-beds between the Campanian and the Santonian did not yield fossils, and are petrologically characterized as a zone of red-marked ("Flammkalke") chalk, almost free of flint-intercalcations. Poorness of flint-intercalcations is also seen in the Santonian, which is distinguished by the hard (sometimes dolomitic) character of its rocks.

The following forms have been identified :—

[S. = Santonian ; C. = Campanian ; M. = Maestrichtian ; D. = Danian.]

GASTROPODA.

Scalaria (*Acrilla*) *desertorum*, Wanner. (M.)
—— cf. *bewertensis*, Whitfield. (C.)
Natica (*Ampullina* ?) *farafrensis*, Wanner. (C.)
? *Turritella* (*Peyrotia*) *aidæ*, Greco. (C.)
—— *reyi*, Lartet. (M.)
Cerithium sp. (nov.). (M.)
Turbo clathratus, Binkhorst. (C.)
Avellana archiaciana, D'Orbigny. (C.)

PELECYPODA.

Nucula tenera, Müller. (C., M.)
Leda perdita, Conrad. (C., M.)
—— *evansi*, sp. n. (M.)
—— sp. (M.)
Grammatodon (?) *parallelus*, Conrad. (C., M.)
Astarte (*Eriphyla*) *lenticularis*, Goldfuss. (C.)
—— sp. ? (D. ?)
Crassatella rothi, Fraas. (C.)
—— *macrodonta*, Sowerby. (C.)
—— *falconieri*, Lartet. (C.)
—— *larteti*, sp. n.
—— *austriaca*, Zittel. (C. or M.)
Lucina dachelensis, Wanner. (C. or M.)
—— (*Dentilucina*) *subnumismalis*, d'Orbigny. (M.)
—— cf. *campaniensis*, d'Orbigny. (M.)
Protocardia sp. (C.)
—— sp. (group *hillana*, Sowerby). (C., M.)
Roudaireia undata, Conrad. (M.)
Meretrix andersoni, Bullen-Newton. (C.)
—— (*Dosiniopsis* ?) *judaica*, sp. n. (C.)
Corbula subelegans, sp. n. (C.)
—— cf. *paracrassa*, Wade. (M.) (C. ?)
—— sp. (C., M.)
Pinna sp. (M.)
Inoceramus regularis, d'Orbigny. (M.)
Pecten (*Camptonectes*) sp. (S.)
—— (*Neithea*) *quinquecostatus*, Sowerby. (S.)
—— (*[illegible]*) *[illegible]*, Conrad. (D.)

Plicatula auressensis, Coquand. (S.)
—— *ferryi*, Coquand. (S.)
Liostrea cf. *rouvillei*, Coquand. (S.)
Ostrea (*Pycnodonta* ?) *hippopodium*, Nilsson. (C.)
ycnodonta vesicularis, Lamarck. (S., C., M.)
xogyra cf. *decussata*, Goldfuss. (S.)
—— *canaliculata*, Sowerby. (M.)

The anthozoa fauna will be separately described by Prof. P. Oppenheim.

Besides several cosmopolitan forms (*Astarte* (*Eriphyla*) *lenticularis*, *Protocardia hillana*, *Pecten quinquecostatus*, *Pycnodonta vesicularis*), most of the fossils show near affinity to, or identity with, faunas of the same age described from North Africa (chiefly Egypt). Some, however, are only recorded from Palestine: *Turritella reyi*, *Grammatodon* ? *parallelus*, *Leda perdita*, and *Crassatella falconieri*. To the latter list could be added five new Palestinian species of Campanian - Maestrichtian age: *Certhium*, sp. n., *Leda evansi*, *Crassatella larteti*, *Meretrix judaica*, and *Corbula subelegans*.

Relationship to the Indian Senonian fauna may only be observed in some of the Maestrichtian forms. As already mentioned in my earlier paper, the latter period appears to represent a great transgression over many parts of the world, and therefore shows in our fauna even common features with some North American species. The Campanian and Santonian fauna contains several European Senonian forms.

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Description of the Fossils.

GASTROPODA.

Some well-known and characteristic forms of gastropods, such as *Turritella reyi*, Lartet, and its varieties, *Scalaria goryi*, Lartet, *Turritella adullam*, Fraas, *Actæon gracilis*, Blanckenhorn, *Natica paludinæformis*, Blanckenhorn, *Natica*

Euspira?) *lyrata*, Sowerby, occur everywhere in the Palestinian Senonian in the region between Wadi Nar and Wadi Kelt (chiefly in typical Maestrichtian beds). In addition to these, a number of forms new to Palestine are described, together with a new species.

Order PROSOBRANCHIA.

Suborder Ctenobranchia.

Family **Scalariidæ.**

Scalaria (*Acrilla*) *desertorum*, Wanner. (Pl. XXI. fig. 1.)

1902. Wanner, Palæontographica, xxx. 2, p. 126, pl. xviii. fig. 16.
1902. Quaas, Palæontographica, xxx. 2, p. 243.

Observations.—*S. desertorum* is known from the "Lybische Kreide" (Maestrichtian) as well as from the "Blatterton" (Danian) in Egypt. According to Pervinquière (1912, p. 62), it occurs also in Tunis at both horizons. Cossmann (1912, p. 58) considers this form to belong to the subgenus *Acrilla*.

Measurements.—Very small individual of only 8–9 mm. in height.

Distribution.—Maestrichtian, in the bituminous limestone, together with *Turritella reyi*, below the green phosphate bank: Wadi Mukelik.

Scalaria cf. *bewertensis*, Whitfield. (Pl. XXI. fig. 2.)

1891. Whitfield, Bull. Amer. Mus. Nat. Hist. iii. p. 421, pl. ix. figs. 8, 9.

Description.—Our specimen has great resemblance to *S. bewertensis*, which, according to Blanckenhorn (1927, p. 138), is an Aptian form. The apex is broken away. Only the last three whorls (volutions) are preserved, and these show an apical angle of 20°–25°. Excepting the straight longitudinal varices, there is no other ornamentation on the whorls. The base is marked by two spiral keels. It seems to be distinguished from *S. bewertensis* by its smaller apical angle, and it is much younger geologically.

Distribution.—Campanian: Way Nebi Nusa to Chan el Ahmar.

Family **Naticidæ.**

Natica (*Ampullina?*) *farafrensis*, Wanner. (Pl. XXI. fig. 3.)

1902. Wanner, Palæontographica, xxx. 2, p. 125, pl. xviii. fig. 12.
1902. Quaas, Palæontographica, xxx. 2, p. 239, pl. xxxii. figs. 26, 27.
1912. Pervinquière, Paléont. tunis. ii. p. 49, pl. iv. figs. 2–4.

This North African form has been sufficiently described [illegible] and Pervinquière.

Observations.—Our small specimen (diameter of the last whorl 6–7 mm.), while well preserved with a smooth shiny surface, does not show the so-called "Gitterstructur" of Quaas. Wanner and Pervinquière also have not observed any other ornamentation apart from the growth-lines. It may be, therefore, that these forms can be placed in the subgenus *Ampullina* (Cossmann, 1925, p. 107).

Distribution.—Campanian: Way Nebi Musa to Chan el Ahmar.

Family Turritellidæ.

? *Turritella (Peyrotia) aidæ*, Greco.

1918. Greco, Palæontographica Ital. xxii. 2, p. 119, pl. xv. fig. 8.

Observations.—The last whorl is not preserved. The following whorls have on the sutures the characteristic banded swellings with corresponding furrows, and this indicates already a more Eocene character of the general form. The apical angle is 26°–28°, which is a little larger than in Greco's examples. Our fragmentary specimen is, therefore, only doubtfully referred to *T. aidæ*.

Distribution.—The same as *Natica farafrensis*.

Turritella reyi, Lartet.

1928. For synonymy, see Blanckenhorn, Palæontographica, lxix.

This fossil is one of the most characteristic of the Palestinian forms. It has been recently described and figured by Blanckenhorn. Attention may here be drawn to the fact that there occurs in the Lower Eocene of Egypt *Mesalia oxycrepsis*, Meyer-Eymar (1895, p. 43, no. 131, pl. ii. fig. 4), a form which in its general aspect is very similar to *T. reyi*, and which Oppenheim (1906, p. 255, pl. xxiii. figs. 19–22) regards as absolutely "isolated" in the Eocene fauna.

Family Cerithiidæ.

Cerithium sp. (nov.). (Pl. XXI. fig. 4.)

Description.—Apical angle 35°. Nine to ten well-rounded whorls with deeply-grooved sutures. The whorls are ornamented with a row of main spiral lines, numbering eight on the last whorl and five on the penultimate whorl. Between each of these main spiral lines is situated a very thin and less prominent secondary spiral line. The whole shell is crossed by a row of fine regularly-placed longitudinal lines, becoming more swollen on the last whorl of the larger specimen; the younger specimen does not show this development, and

produces on the last whorl a uniform lattice-structure. As both specimens are slightly compressed, we remark only that the peristoma possesses a regular swelling on the exterior lip.

Measurements.—Height 17 mm. (and 8–9 mm.). Last whorl: height 6 mm., breadth 9 mm.

Observations.—This form undoubtedly represents a species new to our Maestrichtian, but, in the absence of further and more complete material, a new name is not given. It shows features resembling the older Gault form, *C. lallierianum*, d'Orbigny (1842, ii. p. 365, pl. ccix. figs. 7–9), from which it differs by a more close ornamentation and smaller apical angle. The Indian types, namely *C. trichinopolitensis*, Forbes (1846, p. 126, pl. xv. fig. 10) and *C. antedens*, Forbes, which Stoliczka (1868, pp. 202, 460, pl. xvi. fig. 5; pl. xix. fig. 4) regarded as identical, are also related to our form.

Distribution.—Maestrichtian, Baculite horizon: near Hassan er Raai, west of Nebi Musa.

Suborder Aspidobranchia.

Family Turbinidæ.

Turbo clathratus, Binkhorst, var. (Pl. XXI. figs. 5 *a*, *b*, *c*.)

1861. Binkhorst, Monogr. Gastérop. Céphalop. Craie sup. Limbourg, p. 48, pl. iii. fig. 7.

Measurements.—Height 15 mm. Last whorl: height 8 mm., breadth 13 mm. Apical angle almost rectangular.

Description.—The shell is covered with fine spiral lines numbering ca. 20 on the last volution, with finer and more numerous longitudinal lines. The latter are recognized under the lens as fine granulated lines. This granulation is to be observed on the younger whorls without the aid of a lens, and in these young whorls the granulated lines number about five. The sutures are well marked and slightly flattened. The peristoma is circular-rounded. The umbo very deep.

Observations.—The figures and description of *T. clathratus* by Binkhorst do not show such pronounced longitudinal lines, and the last whorl is more swollen. Both differences seem to be insufficient on which to base a new species, and we distinguish our form only as a Palestinian variety of *T. clathratus*.

T. rimosus, var. *granulata*, Kaunhowen (1898, p. 33, pl. ii. figs. 4–6), appears to belong to *T. clathratus*. Ornamentation and suture are quite different from *T. rimosus*, Binkhorst,

and is very close to our form. There may be some relationship to *Turbo goupilanus*, d'Orbigny (1842, ii. p. 222, pl. clxxxv. figs. 7–10).

Distribution.—(Upper Campanian), together with true Campanian forms: New Jericho Road.

Order OPISTHOBRANCHIA.

Suborder Tectibranchia.

Family **Actæonidæ**.

Avellana archiaciana, d'Orbigny, var. (Pl. XXI. fig. 6.)

1842. D'Orbigny, Pal. franç. terr. Crét. ii. p. 137, pl. clxix. figs. 7–9.
1888. Holzapfel, Palæontographica, xxxiv. p. 84, pl. vi. figs. 19–21 (*Cinulia humboldti*).
1912. Pervinquière, Paléont. tunis. ii. p. 87, pl. vi. figs. 8–9.

Observations.—Our example is 10 mm. high and does not show the fine longitudinal lines of d'Orbigny's holotype. Pervinquiére has already stated that *Cinulia humboldti*, Holzapfel, belongs to *A. archiaciana*. Holzapfel figures also such forms without the longitudinal lines.

The high number (almost 40) of spiral lines in our forms, in spite of the general high variability of *A. archiaciana*, convinces us that it is a distinct variety.

So far as one can gather from Blanckenhorn's (1927, p. 182) remarks, *Avellana* sp. probably belongs to the same group of *A. archiaciana*.

A. archiaciana is consequently a widely-distributed Upper Senonian fossil.

Distribution.—Campanian: crossway between the Wadi Sammara and the wide path Ain Feschcha to Marsaba.

PELECYPODA.

Order HOMOMYARIA.

Suborder Taxodonta.

Family **Nuculidæ**.

Genus Nucula.

Nucula tenera, Müller. (Pl. XXI. figs. 7 *a*, *b*, 8–10.)

1847. Müller, Petref. Aachener Kreidef. Abt. i. p. 17, pl. ii. fig. 1.
? 1852. Conrad, Off. Rep. Exped. Dead Sea, p. 223, pl. xvii. figs. 92–93 (*N. crebrilineata*).

1872, 1877. Lartet, Geol. Palestine, p. 55, pl. xiii. fig. 3; id., La Mer Morte, p. 133, pl. xii. figs. 11–12 (*N. crebrilineata*).
1889. Holzapfel, Palæontographica, xxxv. p. 200, pl. xxi. figs. 9–12.
1902. Wanner, Weisse Kreide Libysch. Wüste, p. 119, pl. xvii. fig. 15 (*N. tremolate-striata*).
1912. Pervinquière, Paléont. tunis. ii. p. 94, pl. vii. figs. 8–14.

Observations.—Our specimens exhibit a great range of variation, and even the figures of Müller, Holzapfel, and Pervinquière are not at all comparable. The variations are mainly observed in the general form, although the ornamentation remains constant.

The differences of the exterior form are chiefly restricted to two characters:—(1) The apical angle changes from 95° in the original type of Müller to 110°–115° in the extreme forms of Pervinquière (figs. 9–10); (2) some of the forms of Müller and Holzapfel have a sharp edge between the ventral and posterior margins, similar to *N. pectinata*, Sowerby (1818, ii. p. 209, pl. cxcii. figs. 6–7), while some of the forms of Pervinquière's and our own are more rounded. These latter specimens appear to be more rounded in their total aspect.

Comparisons.—In comparing a series of *Nucula* from Palestine, North Africa, and India, we come to the conclusion that these fossils, attributed to different species, almost all belong to the characteristic species of *N. tenera*, Müller.

N. crebrilineata, Conrad, is insufficiently described and figured, and although Lartet later gave two figures, he did not add to the description. Nevertheless, we are able to recognize that Lartet's fig. 11 belongs more or less to Müller's type, and his fig. 12 to the (extreme) forms of Pervinquière. So far as Stolickza's fig. 24 (1870, p. 329, pl. xvii.) and his description of *N. bidorsata* allows, this species should be referred to the *N. tenera* group. Finally, Fourtau has drawn attention to the near relationship of *N. tremolate-striata*, Wanner, and *N. crebrilineata*, Lartet. According to Fourtau (1917, p. 3) the main difference between *N. tremolate-striata* and *N. tenera*, Müller, consists only in the less strongly-developed sculpture of the shell, a character which does not allow of the specific separation of the two forms. Moreover, most of the collected material is not always well preserved.

Relations.—Related forms are *N. pectinata*, Sowerby (1818, ii. p. 209, pl. cxcii. figs. 6–7), *N. pulvillus*, Müller (1859, p. 11, pl. vii. fig. 11), *N. subredempta*, Böhm (1891, [illegible] pl. iii. fig. 16), and *M. redempta*, Zittel (1863, p. 164,

pl. ix. fig. 3). These forms differ mostly in the various development of the areas, apical angles, and ornamentation.

Wade (1926, p. 39, pl. viii. figs. 1–4) figures the species *N. percrassa*, Conrad, and this is a similar form, distinguished by a more obtuse apical angle and a higher-vaulted shell.

It may, moreover, be observed that the above-mentioned related forms of older geological age are characterized generally by a well-marked area, while this character is not so definite as in our Upper Senonian fauna.

Distribution.—*N. tenera* occurs already in the Campanian, and is chiefly represented by the rectangular forms of Müller. All variations are found in the Maestrichtian: Jericho Roads, Wadi Kelt, Nebi Musa, etc.

Genus Leda.

Leda perdita, Conrad. (Pl. XXI. figs. 11 *a*, *b*, 12.)

1852. Conrad, Off. Rep. Dead Sea Exped. p. 223, pl. xvii. fig. 96 (? Appendix, pl. i. fig. 5).

1872, 1877. Lartet, Geol. Palestine, p. 50, pl. xii. figs. 1–2; id., Explor. Géol. p. 126, pl. xii. figs. 1–2.

1917. Fourtau, Cat. Inv. Egypt, Lamellib. terr. crét. pt. 2, p. 5, pl. ii. figs. 7–9.

Observations.—Two extreme types, connected by passage-forms, can be selected from the numerous specimens. These extreme types are: (1) wide and low (fig. 11 *a*); (2) short and high (fig. 12). Fourtau has already studied these differences and named the wide and low type *L. perdita*, var. *sinæa*, while the short and high type he regards as represented by the figures of Lartet—the original type. Fourtau was unable to compare his forms with the original figures of Conrad, and it may be pointed out that Fourtau's var. *sinæa* is nearer to Conrad's figures than those of Lartet. Conrad's figures are, however, relatively higher, a fact which could be caused not so much by depression as by bad drawing, for this latter defect may often be observed in his memoir.

Description.—In profile, like a "ship-keel" (Fourtau), and such wide types are very inequilateral. This latter feature is less marked in the short, higher, and more swollen types (Lartet's forms), and they do not show the beak-shaped curvature of the posterior ventral part. Growth-lines numerous (ca. 50) and well developed.

Measurements.—Characteristic for all examples of *L. perdita* is the sharp posterior margin, which together with the anterior margin form an apical angle of about 150°.

Taking the edge of the umbo as a fixed point, we have the following proportions between the posterior, anterior part, total length and total height :—

Posterior part,	anterior part	=Length.	Height.	Types.
7	6·5	=13·5 mm.	8	Comparatively
8	7·5	=15·5 mm.	9	short.
11	6	=17 mm.	7	Comparatively
10	8	=18 mm.	7	wide.

Relations.—Lartet regarded *L. perdita* as related to *L. lineata*, Sowerby (1835, p. 342, pl. xvii. fig. 9, *Nucula*), *Yolida striatula*, Forbes (1846, p. 148, pl. xvii. fig. 14), and *L. mariæ*, d'Orbigny (1848, p. 169, pl. ccci. figs. 4–6, *Nucula*).

Fraas (1867, p. 92) considered it as synonymous with *L. scapha*, d'Orbigny (1848, pl. ccci. figs. 1–3, *Nucula*). But *L. scapha* has a finer ornamentation, which is sometimes absent, and a long and different anterior margin, which in the true *L. perdita* is well rounded, short, and enters into the ventral margin without any passage.

L. lineata, Sowerby, is nearly equilateral and has a weakly-developed sculpture. *Yoldia striatula*, Forbes, has a broad posterior part, and is generally a very high shell. The Gault *L. mariæ* differs in the apical angle, in its broad intercostal spaces, and consequently fewer growth-lines. We consider, with Fourtau, that *Yoldia scaphuloidea*, Stoliczka, belongs to *L. perdita*.

Distribution.—Campanian and Maestrichtian Beds: the whole area.

Leda evansi *, sp. n. (Pl. XXI. fig. 13.)

Two examples resemble *L. perdita* in being inequilateral and having a similar apical angle. The chief differences lie in the strong and small number (10–11) of growth-lines, with very large intercostal spaces, for in the same sized *L. perdita* there are four and five times the number.

Distribution.—Both specimens are from typical Maestrichtian beds: (*a*) Wadi Mukelik, (*b*) Police Station on the Jericho Road.

Leda sp.

Some badly-preserved specimens, from which one has the unusual length of 27 mm. and 10 mm. height, are reminiscent of *L. leia*, Wanner (1902, p. 120, pl. xvii. fig. 16).

* Dedicated to Dr. J. W. Evans, F.R.S., Director of our Expedition.

Family Arcidæ.

Genus Grammatodon (?).

Grammatodon (?) *parallelus*, Conrad. (Pl. XXI. figs. 14 *a*, *b*.)

1852. Conrad, Off. Report, p. 223, pl. xvii. fig. 98 (*Cucullea*); pl. xvii. fig. 95 (*C. lintea*).
1867. Fraas, Aus d. Orient. i. p. 89 (*Arca securis*).
1872. Lartet, Geol. Palestine, p. 55, pl. xii. fig. 7 (*Arca*).
1877. Lartet, Voyage d'Expl. Mer. Morte, p. 134, pl. xii. fig. 3 (*Macrodon*).
1905. Blanckenhorn, Geol. Umg. Jerusalem, p. 111 (*Macrodon*).

We possess some good specimens with unusually well-preserved hinges, and these allow one to critically examine this form which is so often referred to the genera *Arca*, *Cucullea*, and *Macrodon*. It is apparent that there is no need to discuss the question of the reference to *Arca* or even *Cucullea*. As regards *Macrodon*, this generic name has been shown to be preoccupied, and was originally used for a species of fish. Instead of *Macrodon*, *Parallelodon* and, later, *Grammatodon** have been introduced. Recently Cox † again studied this question, and in comparing the form of the shells, arrives at the result that *Parallelodon* is not identical with *Grammatodon*. But it seems still more important for solving this question to make a comparison of the hinge-structure.

The genotype of *Macrodon* = *Parallelodon* is *Cucullea hirsonensis*, d'Archiac. This form has only a rŏw of parallel postero-lateral teeth and on the anterior end some small vertical teeth.

The genotype of *Grammatodon* is *Arca* (*Cucullea*) *inornata*, Meek & Hayden. But, as we have no figures of the hinge nor material for comparison (Woods and Cox did not know the hinge of the genotype), and since the modern American literature gives no indication, the position of *Grammatodon* with its genotype *G. inornatus* remains absolutely uncertain.

Regarding Wood's types of *Grammatodon*, the development of the hinge in his *G. carinatus* (1899, i. p. 44, pl. vii. figs. 14, 15; pl. viii. figs. 1–8) is different from that of *Parallelodon*. The small vertical teeth in Wood's specimen are situated between the hinge-centre and the anterior end, while on the posterior part of the hinge two gently-curved

* Woods, Ann. & Mag. Nat. Hist. 1899, p. 47 (with literature references).

† Cox (Proc. Dorset Nat. Hist. & Antiquar. F. Cl. 1925, p. 127) discusses also *Beushausenia* = *Parallelodon*.

horizontal teeth are placed. The Cretaceous specimens of *Grammatodon* of Woods are therefore distinguished from the genotype of *Parallelodon* not only by their form (Cox), but also in the different structure of the hinge.

Both Cretaceous forms (*G. securis* and *G. carinatus*) should therefore be placed in a separate group (genus or subgenus), which, according to the structure of the hinge, comes between the genus *Cucullea* and *Parallelodon*. To this group belong our examples, in which the characters of the hinge are especially clearly seen. For this reason *Cucullea parallela*, Conrad, is referred to the *Grammatodon* (?) of Woods. The query may nevertheless express the uncertainty of this generic name, so long as we are unable to compare the hinge of the genotype *Grammatodon*, Meek & Hayden.

Description.—Hinge: The hinge of *G. parallelus* shows four posterior horizontal teeth, of which the uppermost tooth is the longest and about two-thirds of the total length of the hinge. Then follow about six short and curved, vertically-directed teeth lying exactly below the umbo of the hinge. On the anterior part are three short horizontal teeth, of which the uppermost is again the longest and connected with the last vertical tooth. The fine striped area is very narrow and occupies nearly the whole length of the hinge.

Form.—The anterior wing of the shell is extraordinarily short; the margin in this part passes into the ventral margin with a parabola-like curvation. The posterior wing of the shell is about four times longer than the anterior. The posterior margin stands almost at right angles to the hinge-line. The disproportion of the hinge elements may also be seen in the situation of the umbo, which lies near the end of the anterior part of the shell. A sharp keel crosses diagonally across the whole shell from the apex to the hinge, and this distinctly separates the posterior wing from the middle part of the shell. On the contrary, the anterior wing gradually merges into the middle part of the shell.

Ornamentation.—The whole shell is covered with about 30 quite prominent radial ribs. On the smaller Campanian forms two or three ribs of the anterior wing of the shell are specially accentuated. These smaller specimens show also stronger accentuation of the horizontal and parallel growth-lines, while in the larger Maestrichtian forms they are often less prominent. These differences between the small and larger forms are, however, not important enough to separate them into two different species, or even varieties.

Relations.—We have been able to compare our forms with the original specimens figured by Woods (1899, i. pl. vii. figs. 14, 15, pl. viii. figs. 1–8). *G. securis*, Leymerie, shows the same ornamentation, but the whole shell is shorter. The umbo is situated nearer to the middle of the hinge; below the umbo lies a much smaller areal field. *G. carinatus* is less closely related and shows very fine radial ribs and more prominent horizontal growth-lines. The umbo is more largely developed and situated near to the middle of the hinge. The area is like *G. parallelus* and extends over almost the whole length of the hinge, but is much less ridged. The horizontal posterior teeth are not so rectilinear as in our form. *G. securis* and *G. carinatus* both show an oblique direction of the posterior margin, while in our form it is at right angles to the hinge-line.

Distribution.—Lartet (1877, p. 134) has already mentioned that *G. parallelus* is invariably compressed. Nevertheless, we have been able to collect some well-preserved specimens on the outcrops of the new Jericho road. *G. parallelus* is found in the Campanian and Lower Maestrichtian.

Suborder Heterodonta.

Family Astartidæ.

Genus Astarte.

Astarte (*Eriphyla*) *lenticularis* Goldfuss.
(Pl. XXI. fig. 15.)

1840. Goldfuss, Petref. Germaniæ, ii. p. 228, pl. cxlvi. fig. 16.
1889. Holzapfel, Moll. Aachener Kreide, p. 195, pl. xiv. figs. 5–7.
1906. Woods, Ann. S. African Mus. iv. p. 301, pl. xxxv. fig. 20 (with literature references).

Observations.—Since Holzapfel's investigations we know that the hinge-structure of this shell has little or no difference from that of the true *Astarte*. Therefore, following Woods, we may for the present regard *Eriphyla* as of subgeneric rank only. *A. lenticularis* is known from India, South Africa, New Zealand, and different parts of Europe. Our own forms are not so well preserved, although readily recognized as a shell belonging to the highly variable group of *A.* (*Eriphyla*) *lenticularis*. They are all of small size (height 18 mm.).

Relations.—*A.* (*Eriphyla*) *forbesiana*, Stoliczka (1870, p. 181, pl. vi. figs. 14–16), and *A.* (*Eriphyla*) *meridiana*, Woods (1917, p. 28, pl. xv. figs. 2–7), are nearly related to our examples. Both forms, however, may be distinguished

by their thinner transverse section and circularly rounded posterior-ventral-anterior margin.

Fraas's (1867, p. 90) examples of *Astarte substriata*, Leym., seem to us to be similar, but without a comparison with the original examples we are unable to solve this question.

Distribution.—Known only from the Campanian: Wadi Sammara, Wadi Mukelik, Wadi Jofet Zeben.

Astarte sp. (?).

Several of our forms with a small number of concentric ribs resemble some of Conrad's figures of *Astarte undulosa* (1852, p. 222, pls. xvi., xvii.). Nevertheless, it remains absolutely uncertain what Conrad meant by his *Astarte* forms—even the genus in most cases is doubtful.

Family **Crassatellidæ**.

Genus Crassatella.

Crassatella rothi, Fraas. (Pl. XXI. figs. 16, 17 *a*, *b*.)

1872. Fraas, Aus. d. Orient. i. p. 90, pl. i. fig. 9.
1896. Mayer-Eymar, Coq. foss. ter. tert. inf. xliv. p. 362, pl. ix. fig. 4.
1902. Wanner, Ob. Kreide Libysche Wüste, p. 121, pl. xviii. figs. 3–4.
1902. Quaas, Oberwegischichten, pp. 208–210, pl. xxiii. figs. 22–29, pl. xxxii. figs. 8–9.
1917. Fourtau, Cat. inv. Lamellib. Egypte, p. 75.
1918. Greco, Fauna cret. Egitto, p. 131, pl. xvi. figs. 8–18.

Observations.—It is difficult to see any important character by which one can separate our examples from those described by several authors as *Crassatella zitteli*, Wanner, or *Crassatella matercula*, Mayer-Eymar. Except for the worn specimens all our examples show characteristic sharp curvature of the concentric ribs in the posterior part of the shell. Extremely well-preserved shells show the hinge-part with a sharp lunular tooth and a broad ligament-groove. Lunule heart-shaped. Escutcheon very long and lancet-shaped. Most of our specimens are small, like those figured by Fraas, with a medium height of 15 mm., but some larger forms give a height of 25–30 mm.

In general the length of the shell is about $\frac{1}{5}$ longer than the height. Fraas gave a length of 15 mm. and a breadth of 10–12 mm. It can be clearly seen from his figure that his breadth corresponds to our height. The exact measurement of the apical angle is difficult, but it is between 100° and 110°. Quaas has specially pointed out the high variability of his specimens, and such high variation can be

observed in our own specimens (mostly var. *lucinoides*). In spite of this fact, it is curious that while he had for investigation some *C. rothi* from the Arabian desert, he did not refer them to *C. zitteli*, but says only that some of his examples of *C. zitteli* "could be placed with the same right in *C. rothi* Fraas."

From the detailed description of Quaas, Fourtau and, later, Greco have adopted for this shell the older name of *Crassatella matercula*, Mayer-Eymar. Pervinquière (1912, p. 249, footnote 3) proposed even a third name, *C. wanneri*. One must, however, give priority to the oldest name, *C. rothi*, Fraas.

Relations.—All of Greco's figures do not appear to belong to *C. matercula* = *C. zitteli* = *C. rothi*. One may recognize from the not always clearly reproduced figures that some of them are similar to *C. austriaca*, Zittel, and others to *C. macrodonta*, Sowerby, emend. Zittel. Conrad's *Astarte undulosa* (1852, p. 222, pl. xvi. fig. 86) corresponds perhaps to our forms. Blanckenhorn (1914, p. 26), in a more recent publication, seems to regard *C. rothi* as an *Astarte*.

The American *Crassatelites linteus*, Conrad (Gardner, 1916, p. 653, pl. xxxix. figs. 6, 7), shows similarity in form and hinge, but distinctly differs in its ornamentation.

Distribution. — Campanian: Wadi Kelt, New and Old Jericho Road.

Crassatella macrodonta, Sowerby. (Pl. XXI. fig. 18.)

1835. Sowerby, Trans. Geol. Soc. London, (2) iii. p. 417, pl. xxxviii. fig. 8 (*Astarte*).
1863. Zittel, Bivalven d. Gosau, p. 151, pl. viii. fig. 1.
1917. Fourtau, Catal. Moll. Lamellib. p. 13 (literature references).

There is little to add to the excellent description of Zittel. *C. macrodonta* is of a typical oblong-trigonal form, with an almost straight posterior margin. In Stoliczka's figures (1870, p. 295, pl. v. figs. 12–14) the posterior wing of the shell is more strongly developed than in our forms, which show a less prominent cross-section. Zittel distinguished a variety *sulcifera*, which is similar to one of our collection.

Distribution.—Campanian: Way Nebi Musa—Chan el Ahmar.

Crassatella falconieri, Lartet. (Pl. XXI. fig. 19.)

1877. Lartet, Voyage d'Expl. Mer Morte, p. 129, pl. xii. figs. 4–5 (non figs. 6–7).

Observations.—Lartet has figured under the name *C. falconieri* two forms, of which one (fig. 6) he regards as

deformed. In our material both forms are represented. We cannot consider this so-called deformed type as belonging to *C. falconieri*, but as constituting a separate species. Lartet's specimen (represented by his figures 4 and 5) remains as the holotype of his *C. falconieri*, and possesses an apical angle of 120°–125°. Comparison with other species of *Crassatella* shows that we have to regard *C. falconieri* as a form of unusually symmetrical construction. Lunule relatively small and with only a small incision. Umbo weakly curved, with a sharp apex. Ornamentation very close-set, but not very prominent. The characteristic keel on the posterior margin of most of the Crassatellæ from the Upper Senonian is only weakly developed in our specimen of *C. falconieri*. The posterior margin passes from the apex of the umbo into the curved ventral margin. Ventral and anterior margins forming a half-circle.

Height : length = 2·3 mm. : 28 mm.

Blanckenhorn (1905, p. 111) considers *C. falconieri* to be identical with *C. syriaca*, Conrad (1852, p. 223, pl. xvii. fig. 100). Conrad's figures seem to be distinctly separated from Lartet's *C. falconieri*, and much more similar to *C. austriaca* Zittel, for they have a more irregular four-sided form, a sharp keel, a smaller apical angle (105° according to the figure).

Distribution.—Campanian: Way Nebi Musa–Chan el Ahmar.

Crassatella larteti, sp. n. (Pl. XXI. fig. 20.)

1877. Lartet, Voyage d'Expl. Mer Morte, p. 129, pl. xii. figs. 6–7 (non figs. 4–5).

Observations.—This so-called deformed form of Lartet is distinguished from *C. falconieri* by its oblong and lower form (height : length = 19 mm. : 31 mm.), more prominent ornamentation, strongly curved umbo, larger escutcheon, and on the left valve a stronger incision of the lunular margin. The (straightened) ventral margin passes gradually into the well-rounded posterior and anterior margin, but the posterior and anterior margins form a more obtuse angle (130°–135°).

Some smaller forms of *C. larteti* (14 mm. : 22 mm.) show a very prominent ornamentation.

Distribution.—Campanian: Old Jericho Road (Pass between Wadi Medba-Aijad and Wadi Kelt), Tellul Abu el Alek (Jericho), Wadi Joref-Zeben.

Crassatella austriaca, Zittel.

1863. Zittel, Bivalven d. Gosau. p. 151, pl. viii. fig. 1 (part i.).
1917. Fourtau, Catal. Moll. Lamellib. p. 73 (literature references).

Distribution.—From the lower bituminous (Campanian?) of the Wadi Mukelik.

Occurrence.—*C. austriaca* is now known from the Upper Senonian of different parts of North Africa and Persia. We have already mentioned the similarity of Conrad's *C. syriaca* from Palestine.

Family **Lucinidæ**.

Genus Lucina.

Lucina dachelensis, Wanner. (Pl. XXI. figs. 21 *a*, *b*.)

1902. Wanner, Weissekreide Libysche Wüste, p. 123, pl. xviii. fig. 6.
1902. Quaas, Overwegischichten, etc., p. 213, pl. xxiv. figs. 8–12.
1917. Fourtau, Cat. Moll. Lamellib. p. 76.

Observations.—Quaas considers all his variable forms to belong to the species *L. dachelensis*, but our specimens agree still closer with the type of Wanner. Fourtau, however, in spite of his general conclusion, namely, "il est rare d'avoir en mains deux individus rigoureusement identiques," separates one form as a variety, *bilata*.

Description.—Our unique but well-preserved specimen is small and swollen, and has the following proportions:—Height : length : thickness = 20 mm. : 21 mm. : 14 mm. The lower keel, which passes over the right valve, is specially sharply developed. The anterior margin has a more rectangular line. Posterior margin gradually curved. Escutcheon very small and oblong. Lunule not very distinct. Ribs more prominent and closer than in Wanner's figures.

Identification.—According to Blanckenhorn (1915, p. 19) *L. dachelensis*, Wanner, should be "identisch mit der noch nirgends beschriebenen und abgebildeten *Lucina hammetensis* Nötling in litt." But since no figure or description, or even the name, has ever been published, priority must be given to Wanner's name.

Distribution. — Campanian (or ? Maestrichtian). Wadi Medba-Aijad.

Lucina (*Dentilucina*) *subnumismalis*, d'Orbigny (var. *pervinquièrei*). (Pl. XXI. fig. 22.)

1850. D'Orbigny, Prodrome de Paléont. iii. p. 241.
1912. Pervinquière, Pal. Tunis, ii. p. 252, pl. xix. fig. 14.

Observations.—One example varies from the type in the

following characters, which were given by Pervinquière for one of his own forms:—"Les valves sont un peu plus renflées, et les côtés sont moins saillants : ce sont plutôt de simples lamelles d'acroissement." It is therefore here proposed to separate this form occurring in Africa and Palestine as var. *pervinquièrei*.

Distribution. — Maestrichtian, phosphate-beds : Wadi Medba-Aijad, on the border of the Jericho plain.

Lucina cf. *campaniensis*, d'Orbigny.

1898. D'Orbigny, Pal. Franç. terr. crét., III. Lamellib. p. 122, pl. cclxxxiii. figs. 11–12.

Unfortunately some small parts of the shell are missing, and we are unable to identify with certainty our form with *L. campaniensis*. Proportions : height : length = 32 mm. : 35 mm. Ornamentation and cross-section conform exactly to d'Orbigny's type. Fraas (1867, p. 93) referred to *L. campaniensis* a shell from Marsaba (in the neighbourhood of our area), but its proportions do not agree with d'Orbigny's figure or with our specimen. Conrad's (1852, p. 226, pl. xix. fig. 115) *L. safedensis* differs from our form in the less numerous and more prominent development of the ribs.

Distribution.—Maestrichtian (zone of *Turritella reyi* and *Baculites vertebralis*) : Hassan er Raai, near Nebi Musa.

Family **Cardiidæ.**

Genus Protocardia.

Protocardia sp.

Shell compressed. The radial ribs are granulated only in the part between the umbo and the middle part of the valve, and then the ventral margin is absolutely smooth. This character agrees with Noetling's (1886, p. 867, pl. xxvii. fig. 1) *P. biserata*, but the concentric ribs are thinner and more numerous, and more closely resemble in this respect his *P. moabitica* (fig. 2).

Protocardia sp. (group *hillana*, Sowerby).

There are several specimens of *Protocardia* with smooth radial ribs nearly related to or identical with Sowerby's group of *P. hillana*. Our material, however, is too badly preserved to solve the problematic position, referred to in an

earlier paper (Picard, 1928, p. 41), of the different forms of Palestinian *Protocardia* of the *P. hillana* group.

Distribution.—Campanian : Maestrichtian.

Family Cyprinidæ.

Genus Roudaireia.

Roudaireia undata, Conrad. (Pl. XXI. figs. 23 *a*, *b*.)

1852. Conrad, Off. Report, p. 222, pl. xvii. fig. 87 (*Opis*).
1862. Coquand, Prov. Constantine, p. 203, pl. xii. figs. 10–11 (*Trigonia*).
1881. Munier-Chalmas, Mission chotts tunis. p. 76, pl. iv. figs. 1–7, pl. v. fig. 1.

Identifications.—The oldest description and figure of a Palestinian *Roudaireia* is to be found in Conrad's *Opis undatus*. His exceptionally clear description, together with his figure, leaves no doubt that we have here a form described later by Coquand as *R. auressensis*, and by Munier-Chalmas as *R. drui*. The structure of the hinge is not given by Conrad, but he describes his *Opis undatus* as belonging to a type very close to the genus *Venelia*, such as *V. conradi*, Morton (1833, p. 294, pl. viii. figs. 1, 2). The genotype of *V. conradi* is, unfortunately, lost, but, nevertheless, in comparing the opinions of the different authors (see Pervinquière, 1912, p. 229), we may say that *Venelia* is only a *Roudaireia* without ribs. Fraas (1867, p. 93, pl. i. fig. 14) has later given the name *Trigonia distans* to our forms.

So long ago as 1890 (p. 82) Blanckenhorn pointed out that *Trigonia distans*, Fraas, and *Opis undatus* ought to be "identified" with *R. drui*. Conrad's name, being the oldest, should therefore be adopted. It is important here to lay stress on this priority, for in the literature both the later names *R. auressensis* and *R. drui* are often used (for synonymy, see Greco, 1916, pp. 135–6), and Whitfield (1891, p. 400, text-fig. 1) even identifies one of his *Platopis* forms with *Opis undatus*, Conrad. Apart from the fact that Whitfield's forms are of Lower Cretaceous age, they are of entirely different appearance, and even belong to the different genus *Platopis*. Whitfield was unable to compare his forms with Conrad's material, which, unfortunately, cannot be found (see Whitfield, 1891, p. 383, footnote).

Similar, and perhaps identical, are some Indian forms of Stoliczka and Noetling described as *Cyprina*.

Distribution.—Base of Maestrichtian (Lower Phosphate-zone), frequently associated with great shallow-water forms such as *Gryphæa vesicularis* and Corals : Old and New Jericho Road.

Family Veneridæ.

Genus Meretrix.

Meretrix andersoni, Bullen Newton.
(Pl. XXI. figs. 24 *a*, *b*.)

1909. Bullen Newton, Cret. Gastr. & Pelecypods Zululand, p. 15 pl. vi. figs. 7–9.
1912. Pervinquière, Pal. Tunis, ii. p. 268, pl. xx. fig. 17.

This low and prominently ribbed form has been sufficiently described in detail by Bullen Newton. Newton, and later Pervinquière, mentioned some nearer related forms, especially *Venus faba*, Sowerby (1827, vi. p. 129, pl. dlxvii. fig. 3). *V. faba* differs, however, in the more close and finer ornamentation, and the shell is always higher in proportion than in our form. *V. immersa*, Müller, is more oblong than our specimen, and is also finely ornamented. Woods (1908, ii. p. 187, pl. xxix. figs. 7–13) includes this latter form in *Cyprimeria faba*. In this wider sense of Woods one could even refer *M. andersoni* to *V. faba*. Pervinquière has already pointed out that *V. faba* should be placed with more justification in *Meretrix* rather than in *Cyprimeria*. Newton regards *V. pacifica*, Moerike (1893, p. 103, pl. vii. fig. 7), as very similar to *M. andersoni* ; but *V. pacifica* is distinguished by its higher form, gradually well-rounded anterior margin, and narrower ribs. The North-American species *Meretrix eufalensis*, Conrad (Wade, 1926, p. 89, pl. xxviii. figs. 3–4), seems to be more closely related.

Pervinquière's specimens are smaller, less well preserved, and therefore indistinctly show the character of the ribs. The identity of Bullen Newton's figures 8 and 9 with our form may clearly be observed, but his fig. 7 differs in the form (not ornamentation), and in this respect stands closer to *V. faba*.

Proportions of our form : Height : length : thickness = 20·4 mm. : 25 mm. : 13·8 mm.

Distribution.—New Jericho Road. As Newton and Pervinquière (p. 269) have been unable to clear up the stratigraphical position of their forms (Pervinquière supposed a Maestrichtian age), it seems to us important to note that our forms have been found associated with a fauna and horizon considered to be the *higher* beds of the Campanian.

Meretrix (*Dosiniopsis*?) *judaica*, sp. n.
(Pl. XXII. figs. 1 *a*, *b* ; 2 *a*, *b* ; 3 *a*, *b* ; 4 ; 5 *a*, *b* ; 6.)

Hinge.—This form shows the characteristic lamellar groove

of the right valve, the corresponding prominent lamellar tooth of the left valve, and three divergent cardinal teeth. The posterior cardinal tooth of the right valve is slightly bifid, the middle cardinal tooth strongly developed. The lamellæ are less prominent on the right valve than on the left.

Form.—Valve slightly inequilateral, anterior margin short and passes gradually and well rounded into the ventral margin. Posterior margin truncated, and forms, with the ventral margin, an obtuse angle. Umbones strongly curved and in contact. Lunule ovate-cordate-shaped and bounded by a slight but well-marked furrow. The whole shell is covered with prominent radial ribs, broader than the intercostal spaces. The valve is very thin, and therefore we have been unable to prepare the sinus and the muscular impressions. The ventral mantle-margin smooth.

Measurements.—About eighty examples of small size. Forms variable, but longer than high, for only in one case is the length and height nearly equal. This latter form may, however, be distinguished as a variety.

					Incompletely preserved.	Variety.	Cast.
Height	10·5	10·9	12·1	14	11·0	13·0	10
Length	12·3	14·0	15·0	16·8	13·2	13·2	11
Thickness ..	7·7	7·8	8·8	9·4	4·8	8·5	6
					only of the right valve.	compressed.	

Relations.—A number of similar forms have been described, but difficulty still remains in making a comparison, since in most cases the hinge is unknown.

M. caperata, Sowerby (1826, vi. p. 31, pl. dxviii. figs. 1–3), which Woods (1908, ii. p. 182, pl. xxviii. figs. 7–10) refers to *Dosiniopsis*, has a distinctly bifid cardinal tooth, while our forms have only a small incision. In this latter respect our hinge resembles the Eocene subgenus *Moerena*, Jukes-Browne (1909, p. 164). *M. caperata* is, moreover, less oblong, larger-sized, with a shorter anterior margin, and the border-furrow of the lunule is missing.

Cythera hörnesi, Zittel (1865, p. 126, pl. iii. fig. 5), differs in its proportions and in its well-rounded posterior-anterior margin.

M. analoga, Forbes (1846, p. 147, pl. xv. fig. 20), differs chiefly in ornamentation, which consists only of very fine growth-lines. *M. cycladella*, Munier-Chalmas (1881, p. 73, pl. v. figs. 2–5), is more symmetrical, less prominently ornamented, and the lunule is different.

Cytherea (*Caryatis*) *abbreviata*, Douvillé (1904, p. 351, pl. L, fig. 1), from Persia, is too badly figured for comparison.

Distribution.—Campanian: in the whole region of the wilderness of Judæa (the species is therefore appropriately named *judaica*).

Suborder Desmodonta.

Family Myidæ.

Genus Corbula.

Corbula subelegans, sp. n. (Pl. XXII. figs. 7 *a*, *b*.)

Form.—Right and left valve of trigonal and equilateral form. Ventral margin of right valve longer than posterior or anterior margin. Posterior and anterior margin nearly of the same size. Left valve almost flattened and enframed by the larger and curved right valve.

Ornamentation.—Left valve slightly polished, and the ornamentation does not show in our examples, but, even if originally present, there could only be slightly raised growth-lines.

Right valve covered with 25 radial and slightly sinuous ribs, of which only the lower 15 are distinctly visible, while the upper 10 ribs are close, thin, and occupy the umbonal part. The latter is broad and flattened. Only the lowest 6–7 intercostal spaces are broader than their dividing ribs; the higher intercostal spaces are of the same breadth or even less than their dividing ribs.

Dimensions.—Length : height = 6·25 mm. : 7·5 mm., and 6 mm. : 7·25 mm. Hinge not visible.

Relations.—Ornamentation of right and left valves and also the form of the left valve are very similar to *Corbula elegans*, Sowerby (1827, vi. p. 139, pl. dlxxii. fig. 1). *C. elegans* differs distinctly in its long prolongation of the posterior part of the right valve, and is therefore strongly inequilateral.

The same differences are to be seen in *C. striatuloides*, Forbes (1846, p. 141, pl. xviii. fig. 14), in which the ribs are also less prominent.

C. angustata, Sowerby (1835, pl. xxxviii. fig. 4), has a shorter prolongation of the right valve, but a much weaker ornamentation.

Bicorbula cf. *exarata*, Douvillé (1904, p. 360, pl. L, figs. 19–20), from Persia, is as equilateral as our forms, but has

a strongly developed and curved left valve; the total form is also much larger.

Conrad's forms of *Corbula* are difficult to compare, because of the bad figures and descriptions. *Corbula syriaca* (Conrad, 1852, p. 222, pl. xxi. fig. 125), however, seems to come closest, but Fraas (1867, p. 92) considers this form to be identical with *C. striatula*, Sowerby (1827, vi. pl. dlxxii. figs. 2–3), a species clearly distinct from our specimen in all its characters.

C. paracrassa, Wade (1926, p. 97, pl. xxxi. figs. 11–12), is nearly related, but is more inequilateral, of larger size, and more strongly ornamented.

Distribution.—Campanian (occurs with *Leda perdita, Nucula tenera, Grammatodon? parallelus, Natica farafrensis,* &c.): Old Jericho Road: Way Nebi Musa–Chan el Ahmar.

Corbula cf. *paracrassa*, Wade. (Pl. XXII. fig. 8.)

1926. Wade, Ripley Formation, p. 97, pl. xxxi. figs. 11–12.

Posterior wing of the valve weakly prolongated as in *C. paracrassa.* Length and height of the same size (9 mm.: 9 mm.). Ornamentation as in *C. subelegans.* Left valve not preserved.

Our right valve is larger and shows a stronger curved umbo than the North American species.

Distribution.—Maestrichtian (Campanian?): border of Jericho mountains (Wadi Medba–Aijad), Mukam Jmam Aly (North of Jericho).

Corbula sp.

A badly preserved right valve shows the posterior prolongation of the *C. elegans* form and similar ornamentation to *C. subelegans.*

Distribution.—Campanian–Maestrichtian: New Jericho Road.

Order ANISOMYARIA.

Family Pinnidæ.

Genus Pinna.

Pinna sp.

An incomplete example of *Pinna* sp. shows in its ornamentation a close similarity to *P. decussata*, Goldfuss (1837, p. 166, pl. cxxviii. figs. 1–2), and *P. cretacea*, Schlotheim (see Zittel, 1865, p. 87, pl. xiii. fig. 1).

Distribution.—Maestrichtian: Hassan er Raai, near Nebi Musa.

Family **Pernidæ.**

Genus INOCERAMUS.

Inoceramus regularis, d'Orbigny. (Pl. XXII. fig. 9.)

(Synonym: *Inoceramus balticus*, Böhm, non *crippsi*, Mantell.)
1843. D'Orbigny, Paléont. Franç., terr. crét. iii. p. 516, pl. ccccx.
1912. Pervinquière, Pal. Tunis. ii. p. 117.

We think it best to follow Pervinquière, who reintroduced d'Orbigny's name of *I. regularis* for this form, which has been so frequently described under different names, more commonly *I. crippsi* and *I. balticus*.

The indefinitely characterized *I. aratus*, Conrad (1852, pl. xix. fig. 113) and Lartet (1877, pl. xi. fig. 15), may possibly belong to *I. regularis*.

Distribution.—Maestrichtian (phosphate-zone, associated with *Baculites vertebralis*): mouth of Wadi Kuneitrah.

Family **Pectinidæ.**

Genus PECTEN.

Pecten (Camptonectes) sp.

The inner part of the lower valve only is preserved. We are nevertheless able to recognize the chief characters, which allows the reference of this specimen to the subgenus *Camptonectes*. The ears are clearly visible, and show on the right a longer wing and a fine denticulation. Ornamentation like that of *P. virgatus*, Nilsson (1827, p. 22, pl. ix. fig. 15), represented by fine radial ribs and less concentric growth-lines. *P. virgatus* is distinguished from our form by its less circularly rounded posterior margin (not seen in Holzapfel's figure, which is similar to our form).

P. (Camptonectes) sp. of Woods (1906, p. 297, pl. xxxv. figs. 12–13), from the Senonian of Pondoland, seems to us identical with *P. virgatus*, Nilsson.

Distribution.—Santonian (associated with *Pecten quinquecostatus*): Wadi Kelt, Wadi Abu Hetmeh.

Pecten (Neithea) quinquecostatus, Sowerby. (Pl. XXII. figs. 10, 11.)

1812. Sowerby, Min. Conch. i. p. 122, pl. lvi. figs. 4–8.
1884. Hamlin, Syrian Molluscan Fossils, p. 61, pl. v. fig. 4.
? 1852. Conrad, Off. Report, p. 230, Appendix, pl. i. fig. 6.

These forms are very small. Both valves mostly found separately.

Vola syriaca, Hamlin, and probably *Janira syriaca*, Conrad, should be referred to *P.* (*N.*) *quinquecostata*.

Distribution.—Lower Santonian (associated with *Camptonectes* sp., *Liostræa* cf. *rouvillei*, Coq., *Dentalium* sp.): Old Jericho Road (Tahuniet et Tahtani); Wadi Kelt–Wadi Abu Hetmeh.

Pecten (*Æquipecten* ?) *obrutus*, Conrad.
(Pl. XXII. fig. 12.)

1852. Conrad, Off. Report, p. 225, pl. xix. fig. 114.
1915. For synonymy, see Blanckenhorn, Danien in Palästina, p. 187.

Blanckenhorn has already pointed out that *P. mayer-eymari*, Bullen Newton, and *P. farafrensis*, Zittel, are synonymous with *P. obrutus*, Conrad. To the detailed description of Wanner (1902, p. 114, pl. xvii. figs. 1–3) and Quaas (1902, p. 168, pl. xx. figs. 6–8; pl. xxxi. figs. 21–23) we have to add that our small valves show a more circularly rounded margin, while the larger specimens are more oval.

Young's forms resemble Holzapfel's figure (Moll. Aachen. Kreide, pl. xxxi. figs. 1–3) of *Pecten pulchellus*, Nilsson, and fig. 13 of Nilsson's *P. lineatus*. Both species have been regarded by Woods as synonymous (Cret. Lamell. i. p. 194).

Distribution.—*P. obrutus* has never been found in the phosphate-beds or lower, but it occurs in the overlying upper, bituminous-limestone horizon. In one case, however, this *Pecten* was found at the base of the still higher mottled-limestone zone. Both zones, the upper bituminous-limestone and the mottled-zone, are regarded as Danian (see Introduction).

Family **Spondylidæ**.

Genus Plicatula.

Plicatula auressensis, Coquand.

1862. Coquand, Géol. Pal. Prov. Constantine, p. 222, pl. xvi. figs. 14–16
1912. Pervinquière, Pal. Tunis. ii. p. 156, pl. xi. figs. 2–18.

Pervinquière regards Lartet's *P. fourneli* and *P. reynesi* as belonging to *P. auressensis*. If we follow this author, who includes even *P. instabilis*, Stoliczka (1870, p. 445, pl. xxxiv. figs. 3–14), *P. auressensis*, originally known as a Cenomanian form, has then a vertical distribution up to the Maestrichtian (Quaas recorded it from the *overwegi*-beds).

All our examples are small, like Pervinquière's example (fig. 10), with a smaller number of ribs (about 6–8).

Distribution. — Lower Santonian: Old Jericho Road (Tahuni et et Tahtani).

? *Plicatula ferryi*, Coquand.

? 1862. Coquand, Pal. Constantine, p. 221, pl. xvi. figs. 7–10.

Some badly preserved specimens from the Santonian of Wadi Kelt and the Campanian of Wadi Kuseira are doubtfully referred to *P. ferryi*.

Family Ostreidæ.

The different specimens of the family Ostreidæ are usually of little value from the stratigraphical point of view.

Genus Liostrea.

Liostrea cf. *rouvillei*, Coquand.

1869. Coquand, Monogr. Genre *Ostrea*, p. 89, pl. xxi. figs. 3–6, pl. xxiv. figs. 7–11.

This long, slightly curved shell conforms very much in its general aspect to *L. rouvillei*. It may be suggested that the often-mentioned but ill-sufficiently described or figured *Gryphæa capuloides*, Conrad (1852, pl. xviii. fig. 103, non fig. 104), possibly belongs to one of the different species of the subgenus *Liostrea*.

Distribution.—Santonian : Old Jericho Road.

Genus Pycnodonta.

Ostrea (Pycnodonta ?) hippopodium, Nilsson.
(Pl. XXI. fig. 13.)

1827. Nilsson, Petref. Suecana, Pars. i. p. 30, pl. vii. fig. 1.

Woods (1912, ii. p. 367, fig. 150) regarded a great number of forms of *Pycnodonta* as synonymous with *P. vesicularis*, and includes also *O. hippopodium*. This double-winged species, however, seems a quite distinguished and isolated form among the different forms of the Ostreidæ, so much so that we are doubtful if we are right in placing it in the genus *Pycnodonta*. *O. hippopodium* possibly represents a distinct genus or subgenus.

Distribution.—Lower Campanian : Old Jericho Road.

Pycnodonta vesicularis, Lamarck.
(Pl. XXII. figs. 14, 15.)

For synonymy, see Fourtau, 1917, pp. 55–56.

As already shown in an earlier paper (Picard, 1928, p. 42), *P. vesicularis*, Lam., and *P. vesiculosa*, Sow., cannot be specifically separated, and the former name takes precedence.

In our view *P. vesiculosa* is to be regarded as a form given to much variation, caused by the different types of sedimentation. For example, in pure limestone and chalk there is a great development of the shell, while in a more argillaceous sediment the shell remains small.

The variation in form is very great, but one can recognize three extreme types of the lower valve, and these are frequently found associated. One has a strong and *Gryphæa*-like curved umbo, another has a truncate umbo, and the third has a wing-shaped prolongation. In the latter type the umbo is not truncated nor distinctly beak-shaped.

As *P. vesicularis* has a range from the Lower Cretaceous to the Danian, it cannot be regarded as a good index to horizon in the Senonian of Palestine, as already stated in other papers.

Distribution.— Santonian–Campanian–Maestrichtian : in the whole region.

Genus Exogyra.

Exogyra cf. *decussata*, Goldfuss.

(See Coquand, 1862, pl. vii.)

Several casts and moulds of strongly keeled and curved forms are regarded as similar to, if not identical with, *Exogyra decussata*, Goldfuss.

Distribution.—Santonian : Wadi Kueisra.

Exogyra canaliculata (J. Sowerby). (Pl. XXII. figs. 16, 17.)

1813. *Chama canaliculata*, J. Sowerby, Min. Conch. i. p. 68, pl. xxvi. fig. 1.

A form with an inturned and strongly curved beak comes near to the genus *Pycnodonta*, particularly to the species *P. vesicularis*. Apart from the inturned beak, the characteristic groove on the umbo and the corresponding infolding of the mantle of the valve distinguishes our form from *P. vesicularis*.

At the same locality occurs a form which we consider to be an extreme variety of *E. canaliculata*. The groove on the umbo is very large, of semicylindrical shape, and extends from the umbo to the middle part of the lower valve. This groove is bordered by two sharp keels, of which one is situated near the middle of the shell.

On this latter keel the growth-lines tend to form a denticulation. The lower valve is small, about 30 mm. in length, and much less curved than in the true *E. canaliculata*.

Our form resembles figs. 156 and 159 (1912, ii. p. 369) of Woods' *P. vesicularis* and Pervinquière's (1912, pl. xii. fig. 27) *Pycnodonta flicki*, but it has not the typical hinge of the species of *Pycnodonta*.

Distribution.—Maestrichtian : Wadi Kueisra.

Literature.

Binkhorst, J. T. v. 1861. 'Monographie des Gastéropodes et Céphalopodes de la craie supérieure de Limbourg.'

Blanckenhorn, M. 1890. 'Beiträge zur Geologie Syriens: Die Entwickelung des Kreide-systems in Mittel- und Nord-Syrien.' 4to, Cassel.

——. 1905. "Geologie der näheren Umgebung von Jerusalem." Z. deutsch. Palästina Ver. xxviii. pp. 75–120.

——. 1914. "Syrien, Arabien, und Mesopotamien." In Steinmann, 'Handbuch der regionalen Geologie,' v. Hft. 4. Heidelberg.

——. 1915. "Das Danien in Palästina mit der Leitform *Pecten obrutus*, Conr." Z. deutsch. geol. Ges. Berlin, lxvii. B, Monatsb. pp. 187–191.

——. 1927. "Die fossilen Gastropoden und Scaphopoden der Kreide von Syrien–Palästina." 'Palæontographica,' lxix. pp. 111–186, pls. v.–x.

Boehm, J. 1891. "Die Kreidebildungen des Fürbergs und Sulzbergs bei Siegsdorf in Oberbayern." 'Palæontographica,' xxxviii. pp. 1–106, pls. i.–v.

Conrad, T. A. 1852. "Description of the Fossils in Syria." Appendix to W. F. Lynch: Official Report of the United States Expedition to explore the Dead Sea and the River Jordan. Baltimore, pp. 211–235, 16 double plates.

Coquand, H. 1862. "Géologie et Paléontologie de la Région Sud de la Province de Constantine." Mém. Soc. émul. Provence, Marseille, ii. pp. 1–339.

——. 1869. 'Monographie du Genre *Ostrea*. Terrains crétacés.' 8vo, Marseille.

Cossmann, M. 1912, 1925. 'Essais de paléoconchologie comparée,' ix. 1912; xiii. 1925.

Cox, L. R. 1925. "The Fauna of the Basal Shell-Bed of the Portland Stone, Isle of Portland." Proc. Dorset Nat. Hist. & Antiq. F. Cl. xlvi. pp. 113–172, pls. i.–v.

Douvillé, H. 1904. "Mollusques fossiles" in J. de Morgan, 'Mission scientifique en Perse.—III. Études géologiques. Pt. IV. Paléontologie.' Paris.

Forbes, E. 1846. "Report on the Fossil Invertebrata from Southern India, collected by Mr. Kaye and Mr. Cunliffe." Trans. Geol. Soc. London, (2) vii. pp. 97–174.

Fourtau, R. 1917. "Catalogue des invertébres fossiles de l'Egypte. Terrains crétacés.—Pt. 2. Mollusques Lamellibranches." Survey Dept. Geol. Surv. Egypt, Palæontological Series, No. 3. Cairo.

Fraas, O. 1867. 'Aus dem Orient.—I. Geologische Beobachtungen am Nil, auf der Sinai Halbinsel und in Syrien.' Stuttgart.

Gardner, J. A. 1916. "Upper Cretaceous Fauna." Maryland Geol. Surv., Baltimore.

Goldfuss, A. 1827–1844. 'Petrefacta Germaniæ,' ii. 1833–1840. [illegible] Dusseldorf.

GRECO, B. 1916–1917. "Fauna cretacea dell' Egitto raccolta dal Figari Bey." Palæontographica Ital. xxii. pp. 103–169, pls. xv.–xix. 1916; xxiii. pp. 93–161, pls. xiii.–xvii. 1917.

HAMLIN, C. E. 1884. "Results of an Examination of Syrian Molluscan Fossils, chiefly from the Range of Mount Lebanon." Mem. Mus. Comp. Zool. Harvard, x. no. 3, 68 pp., 6 pls.

HOLZAPFEL, E. 1888, 1889. "Die Mollusken der Aachener Kreide." 'Palæontographica,' xxxiv. pp. 29–180, pls. iv.–xxi. 1888; xxxv. pp. 139–268, pls. viii.–xxix. 1889.

JUKES-BROWNE, A. J. 1909. "On the Genera of Veneridæ represented in the Cretaceous and older Tertiary Deposits." Proc. Malac. Soc. London, viii. pp. 148–177, pl. vi.

KAUNHOWEN, F. 1898. "Die Gastropoden der maestrichter Kreide." Palæont. Abhandl. viii. pp. 3–132, pls. i.–xiii.

LARTET, L. 1869–1872. "Essai sur la géologie de la Palestine et des contrées avoisinantes telles que l'Egypte et l'Arabie, etc." Ann. Sci. Geol. i. pp. 5–116, 1869; iii. pp. 1–96, pls. ix.–xii. 1872.

——. 1877. "III." in Duc de Luynes: 'Voyage d'exploration à la Mer Morte, à Petra et sur la rive gauche du Jourdain.' Paris.

MAYER-EYMAR, C. 1887, 1895, 1896. "Description de Coquilles fossiles des terrains tertiaires inférieures." Journ. Conchyliologie, xxxv. pp. 311–322, 1887; xliii. pp. 152–164, pl. vii. 1895; xliv. pp. 356–366, 1896.

MOERIKE, W. 1895. "Die Gastropoden und Bivalven der Quiriquina-Schichten." N. Jahrb. f. Min., Beil. Bd. x. pp. 95–118.

MORTON, S. G. 1833. "Supplement to the Synopsis of the Organic Remains of the Ferruginous Sand-formation of the United States." Amer. J. Sci. xxiii. pp. 288–294, 2 pls.

MÜLLER, J. 1847–1859. 'Monographie der Petrefakten der Aachener Kreideformation.' Bonn, i. 1847; ii. 1851; Supplement Aachen, 1859.

MUNIER-CHALMAS, E. 1881. "Note paléontologique etc.," in Roudaire, 'Mission dans les chotts tunisiens,' pp. 59–79. Paris.

NEWTON, R. BULLEN. 1909. "Cretaceous Gastropoda and Pelecypoda from Zululand." Trans. Roy. Soc. S. Africa, i. pt. i. pp. 1–106, 9 pls.

NILSSON, S. 1827. 'Petrificata Suecana, Formationis Cretaceæ.' Londini Gothorum.

NOETLING, F. 1886. "Entwurf einer Gliederung der Kreideformation in Syrien und Palästina." Z. deutsch. Geol. Ges. Berlin, xxxviii. pp. 824–875, pls. xxiv.–xxvii.

OPPENHEIM, P. 1903, 1906. "Zur Kenntnis altertiärer Faunen in Ägypten." 'Palæontographica,' xxx. Abt. 3, pp. 1–348, pls. i.–xxvii.

ORBIGNY, A. D'. 1842–1848. 'Paléontologie française. Description des Mollusques et Rayonnés fossiles. Terrains crétacés. II. Gastropodes, III. Lamellibranches.'

——. 1850. 'Prodrome de Paléontologie stratigraphie universelle des animaux Mollusques et Rayonnés II.' Paris.

PERVINQUIÈRE, L. 1912. "Études de Paléontologie tunisienne.—II. Gasteropodes et Lamellibranches des terrains Crétacés." Cart. Geol. tunisie. Paris.

PICARD, L. 1928. "Zur Geologie der Kischon ebene." Z. deutsch. Palästina-Ver. li. pp. 5–72.

QUAAS, A. 1902. "Beiträge zur Kenntnis der Fauna der obersten Kreidebildungen in der libyschen Wüste.—II. Die Fauna der Overwegischichten und der Blättertone." 'Palæontographica,' xxx. Abt. 2, pp. 153–334, pls. xx.–xxxiii.

SOWERBY, J., & SOWERBY, J. DE C. 1812–1846. 'Mineral Conchology of Great Britain,' i–vii. London.

SOWERBY, J. 1835. "Table of Fossils found in the Gosau Deposit etc.," in Sedgwick and Murchison, Structure of the Eastern Alps. Trans. Geol. Soc. London, (2) iii. pp. 417–420.

STOLICZKA, F. 1868, 1870. "Cretaceous Fauna of Southern India." 'Palæontologica Indica,' Mem. Geol. Surv. India, Gastropoda, ii. 1868; Pelecypoda, iii. 1870.

WADE. B. 1926. "The Fauna of the Ripley Formation on Coon Creek, Tennessee." U.S. Geol. Surv., Prof. Paper no. 137.

WANNER, J. 1902. "Die Fauna der obersten weissen Kreide der libyschen Wüste." 'Palæontographica,' xxx. Abt. 2, pp. 91–151, pls. xiii.–xix.

WHITFIELD, R. P. 1891. "Observations on some Cretaceous Fossils from the Beyruth District." Bull. Amer. Mus. Nat. Hist. iii. pp. 381–441, pls. iii.–xi.

WOODS, H. 1899–1913. 'Cretaceous Lamellibranchia of England.' Palæontogr. Soc. London. 2 vols.

——. 1899. "Note on the Genus *Grammatodon*, Meek & Hayden." Ann. & Mag. Nat. Hist. (7) iii. pp. 47–48.

——. 1906. "The Cretaceous Fauna of Pondoland." Ann. S. African Mus. iv. pp. 275–350, pls. xxxiii.–xliv.

——. 1917. 'The Cretaceous Faunas of the North-Eastern part of the South Island of New Zealand.' N.Z. Geol. Surv. Palæont. Bull. no. 4, pp. iii+41, 20 pls.

ZITTEL, K. A. v. 1865, 1866. "Die Bivalven der Gosaugebilde." Denkschr. Akad. Wiss. Wien, Math.-Nat. Kl. xxiv. pp. 105–177, pls. i.–x., 1865; xxv. pp. 77–198, 17 pls., 1866.

EXPLANATION OF THE PLATES.

[The figures are of natural size unless otherwise stated.]

PLATE XXI.

All specimens are of Campanian or Maestrichtian age.

Fig. 1. *Scalaria* (*Acrilla*) *desertorum*, Wanner, × 2.
Fig. 2. *Scalaria* cf. *bewertensis*, Whitfield.
Fig. 3. *Natica* (*Ampullina*?) *farafrensis*, Wanner, × 2.
Fig. 4. *Cerithium* sp. (nov.).
Figs. 5 *a*, *b*, *c*. *Turbo clathratus*, Binkhorst, × 2. 5 *c*, apertural view.
Fig. 6. *Avellana archiaciana*, d'Orbigny, × 2.
Figs. 7 *a*, *b*, 8, 9, 10. *Nucula tenera*, Müller. 7 *a*, right valve; 7 *b*, left valve; 8, right valve; 9, left valve; 10, right valve.
Figs. 11 *a*, *b*, 12. *Leda perdita*, Conrad. 11 *a*, right valve; 11 *b*, dorsal view; 12, right valve.
Fig. 13. *Leda evansi*, sp. n. Right valve.
Figs. 14 *a*, *b*. *Grammatodon* (?) *parallelus*, Conrad. 14 *a*, left valve; 14 *b*, interior of left valve.
Fig. 15. *Astarte* (*Eriphyla*) *lenticularis*, Goldfuss. Left valve.
Figs. 16, 17 *a*, *b*. *Crassatella rothi*, Fraas. 16, right valve; 17 *a*, right valve; 17 *b*, interior of right valve.

Fig. 18. *Crassatella macrodonta*, Sowerby. Right valve.
Fig. 19. *Crassatella falconieri*, Lartet. Left valve.
Fig. 20. *Crassatella larteti*, sp. n. Left valve.
Figs. 21 *a*, *b*. *Lucina dachelensis*, Wanner. *a*, left valve; *b*, right valve.
Fig. 22. *Lucina* (*Dentilucina*) *subnumismalis*, d'Orbigny. Right valve, $\times \frac{1}{2}$.
Figs. 23 *a*, *b*. *Roudaireia undata*, Conrad. *a*, right valve; *b*, interior of right valve.
Figs. 24 *a*, *b*, *c*. *Meretrix andersoni*, Bullen Newton. *a*, right valve; *b*, left valve; *c*, dorsal view.

PLATE XXII.

Figs. 10, 11, 13 of Santonian age; 1–9 and 14–17 of Campanian-Maestrichtian age; 12, of Danian age.

Figs. 1 *a*, *b*, 2 *a*, *b*, 3 *a*, *b*, 4, 5, 6. *Meretrix* (*Dosiniopsis*?) *judaica*, sp. n. 1 *a*, left valve; 1 *b*, right valve; 2 *b*, left valve; 3 *a*, right valve, with compressed ventral margin; 3 *b*, dorsal view, showing the lunular groove; 4, right valve of variety; 5, interior of right valve, $\times$ 2; 6, interior of left valve, $\times$ 2.
Figs. 7 *a*, *b*. *Corbula subelegans*, sp. n. *a*, left valve, $\times$ 2; *b*, right valve, $\times$ 2.
Fig. 8. *Corbula* cf. *paracrassa*, Wade. Right valve.
Fig. 9. *Inoceramus regularis*, d'Orbigny, $\times \frac{1}{2}$.
Figs. 10, 11. *Pecten* (*Neithea*) *quinquecostatus*, Sowerby. 10, left valve; 11, right valve.
Fig. 12. *Pecten* (*Æquipecten*?) *obrutus*, Conrad. Right valve.
Fig. 13. *Ostrea* (*Pycnodonta*?) *hippopodium*, Nilsson. Left valve, $\times \frac{1}{2}$.
Figs. 14, 15. *Pycnodonta vesicularis*, Lamarck. $\times$ 14, left valve with wing-shaped prolongation; 15, left valve without prolongations.
Figs. 16, 17. *Exogyra canaliculata*, Sowerby. 16, lateral view of left valve; 17, left valve of a variety.

LII.—*Preliminary Notices of Two new Snails from the Colorado Desert.* By S. STILLMAN BERRY, Redlands, California.

As it is desired to use the names in another connection, brief preliminary diagnoses of two hitherto undescribed desert snails are offered herewith. More complete descriptions and figures of these and other allied species are to be included in a more extensive faunal and distributional paper now in preparation.

Micrarionta (*Eremarionta*) *mille-palmarum*, sp. n.

Diagnosis.—Shell helicoid, small, thin, depressed-conic; whorls averaging about $4\frac{1}{2}$, strongly convex, the last descending parietally. Aperture rounded-oval, oblique. Peristome hardly thickened, and expanded little or not at all except at

the umbilicus; the latter wide, contained 6 to 7½ times in the diameter of the shell. Embryonic whorls somewhat swollen, ornamented with numerous clean-cut and regularly arranged microscopic papillæ, replaced on the subsequent turns by smaller, rounder, and more distant papillations which are obsolete on the body-whorl. Periostracum thin and polished, Vinaceous-Buff, paling below, and with a narrow supra-peripheral band of Prout's Brown, bordered lighter.

Max. diam. 12·1, alt. 7·3, diam. umbilicus 1·9 mm.

Type.—Cat. No. 6502 of the author's collection. Paratypes to be deposited in the collections of Mr. Allyn G. Smith, the San Diego Museum, and the Academy of Natural Sciences of Philadelphia.

Type-locality.—Thousand Palms, Riverside County, California (*S. S. Berry and L. G. Ingles*).

Remarks.—This, the smallest helicoid of the Coachella Valley district so far to be described, curiously recalls the Arizonan *M. hutsoni*, Clapp, but the shell-texture and the strong convexity of the early whorls serve to distinguish it, while, of course, the habitat is widely removed.

Micrarionta (*Eremarionta*) *callinepius*, sp. n.

Diagnosis.—Shell helicoid, of moderate size and thickness, low-conic; the whorls about 4½, convex, increasing rapidly in size; the body-whorl ample, inflated, strongly descending parietally. Aperture large, rounded to rounded-ovate, oblique. Peristome well expanded, especially at the umbilicus; the latter of but moderate width, being contained on the average about 8·6 times in the diameter of the shell. Embryonic whorls slightly swollen and ornamented with exceedingly numerous and in good specimens very clear-cut and regularly arranged papillæ; later whorls at first with a few more distant, minute, rounded papillations which soon become obsolete. Colour of fresh specimens whitish below, above clouded with the usual light brownish fawn, and with a conspicuous brown spiral band shaded lighter.

Max. diam. 20·0, alt. 12·3, diam. umbilicus 2·4 mm.

Type.—Cat. No. 7053 of the author's collection. Paratypes to be deposited in the collections of Mr. Allyn G. Smith, the San Diego Museum, and the Academy of Natural Sciences of Philadelphia.

Type-locality.—South slope of Santa Rosa Mountains, east of mouth of Rockhouse Canyon, San Diego County, California (*E. C. Jaeger*).

Remarks.—Characters to be noted in this species are the size, open umbilicus, tumidity of the body-whorl, large aperture, and the abundance and beautiful regularity of the embryonic sculpture which has suggested the specific name. It admittedly appears to stand rather near to the still poorly understood *indioensis* (Yates), and may eventually be connected therewith as the intermediate area is more thoroughly explored. On the other hand, it is strikingly distinct from its more immediate neighbour, the larger and more discoid *M. borregoensis*, Berry.

LIII.—*Notes on certain Controversial Points of Morphology of the Abdomen and Genitalia of* Psyllidæ. By F. Muir.

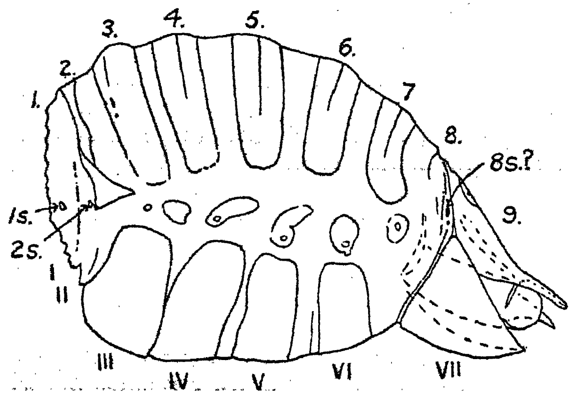
There is already a considerable literature on the morphology of the Psyllidæ, but there are certain questions which are not yet settled to the satisfaction of some, such as the number of abdominal spiracles, the interpretation of the abdominal tergites and sternites, the nature of the dorsal and ventral genital plates in the female, and the nature of the male genitalia. Most of the work has been done without any, or with very little, consideration of the rest of the Homoptera, and so some conclusions have been arrived at which, if true, would place the family apart from all other Homoptera. My only reason for adding to the literature is because I believe that a comparison with other Homoptera will lead to a more normal view, and so place the family in truer relationship with its allies.

Female abdomen (fig. 1).—In the Homoptera the first two abdominal segments are greatly reduced and constricted; the first is entirely, or nearly entirely, membranous; in the second the tergite is very short, often a mere strip, the sternite also being very small. The two spiracles of these segments are near together, but quite distinct. This is the condition found in Psyllidæ. In *Psylla mali* the third, fourth, fifth, sixth, and seventh tergites are large and well defined; the eighth tergum is membranous without a tergite. The ninth tergum forms the dorsal genital plate bearing the anus. The tenth and eleventh segments are only represented by the membrane around the anus. In figures such as shown by Speyer * the membranous area between the seventh and ninth tergites is not shown, and is misleading. The reduction

* 'Der Apfelblattsauger,' 1929, p. 15, fig. 4. ♀.

or loss of the eighth tergite is not an uncommon feature in the Homoptera. In forms such as *Capelopterum* (Issidæ) the eighth tergite is reduced but is still recognizable, and the spiracle is normal. The first sternum is membranous and the second bears a small sternite; the third, fourth, fifth, and sixth sternites are large and normal; the seventh forms the large subgenital plate. This is quite according to what we find in other Homoptera; in the Derbidæ this plate is very conspicuous and is often amalgamated with the *eighth tergite* to form a ring segment which bears the eighth spiracle. As this can be followed back through a gradate series, there is no reason to doubt this interpretation.

Fig. 1.



Psylla mali.

Lateral view of female abdomen, cleared and somewhat flattened. *1–9*, terga; I–VII, sterna; *1s.*, *2s.*, first and second abdominal spiracles; *8s.*, ? probable eighth abdominal spiracle.

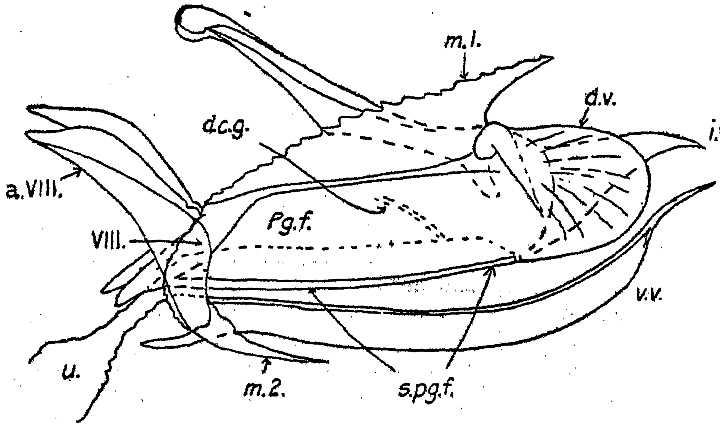
The first two spiracles are near together in the normal position for the Homoptera; the third, fourth, fifth, sixth, and seventh are all normal and in their normal position; the eighth is missing, or only represented by a scar situated a little dorsal of the lateral basal corner of the seventh sternite (fig. 1, *8s.?*).

There is absolutely no evidence to support the idea that the subgenital plate is formed by the *ninth tergite*, and there is no need to suppose that such an abnormal dislocation takes place. In no Homopteron does the ovipositor lie on the ventral side of the *tenth* tergum, but always on the *ninth*; the dorsal valvula at its base rests on the valvifer, which represents a

part of the *ninth* sternum. It is therefore necessary to give very conclusive evidence before we can accept the dorsal genital plate as the tenth tergite and the ventral genital plate as the ninth tergite.

In the vast majority of Homoptera the eighth sternite is divided into two sclerites, and a ventral vulvula is attached to each, often along its inner or mesal margin. Brittain * names these sclerites basivulvulæ, but in Orthoptera this is not the sternite but a sclerite interposed between the shaft of the ventral vulvula and the eighth sternite. In the Psyllidæ the greater portion of the structure is an internal apodeme,

Fig. 2.



Psylla mali.

Lateral view of female genitalia. VIII., eighth sternite (lateral plates); *a.*VIII., apodeme of VIII.; *d.c.g.*, cement duct; *d.v.*, dorsal vulvula; *i.v.*, inner vulvula; *m.*1, membrane connecting *Pg.f.* to ninth tergum; *m.*2, membrane connecting VIII. to seventh sternum; *Pg.f.*, pygofer; *s.pg.f.*, slender sclerite connecting *d.v.* with *v.v.*; *u.*, uterus; *v.v.*, ventral vulvula.

only a small part being the sclerite (fig. 2, VIII. and *a.* VIII.). In Homoptera, especially in the Fulgoroidea, I think it would be a convenience if these selerites were called the *lateral plates*.

In the ovipositor it is highly probable that the inner vulvulæ are represented only by the fused angular plates between the dorsal vulvulæ; the long thin sclerites from these plates (fig. 2, *s.pg.f.*) to the base of the ventral vulvulæ

* Proc. Acadian Ent. Soc. 1923, no. 8, pl. iv.

being sclerotizations of the ventral portion of the ninth segment corresponding to the pygofer in many female fulgorids*. The fact that the single median duct (cement gland?) opens on to the membrane between these two slender sclerites near to the fused inner vulvulæ lends weight to this conclusion. This membrane between the slender sclerites is continuous with the dorsal (posterior) wall of the uterus. The large apodemes and the peculiar structure of the ovipositor are likely to be connected with peculiarities of the eggs, which are abnormally large for the size of the insect, and hardened before they leave the uterus.

Male abdomen.—The first two segments are reduced in a manner similar to those in the female; the third to eighth sternites are well defined, and so are the third to seventh tergites; the eighth tergum is membranous, and a tergite cannot be made out. The first to seventh spiracles are distinct, but no eighth has been recognized. The ninth tergite does not form a ring segment along with the ventral part of the pygofer, it is either amalgamated with the base of the anal segment, as in the Derbidæ, or it is absent.

Dr. Hem Singh-Pruthi in his work on the male genitalia in Rhynchota†, when discussing the Psyllidæ (p. 234), states:—"The genitalia in all respects resemble those of Fulgoroidea, especially Cixiidæ," and in his diagram (fig. 3, p. 237) places them next to the Fulgoroidea and far away from the Coccidæ. This is so contrary to conclusions based upon other characters that one is inclined to believe that there is some error. I believe it is due to his misunderstanding the nature of the different types found in the Homoptera, more especially of those parts which he calls the basal plate and basal plate prolongation. It may therefore serve a useful purpose if we can recognize certain morphological differences which will place the Psyllidæ in a more natural position.

In the male homopteron the area circumscribed by the base of the tenth abdominal sternite and the margins of the pygofer is occupied by a membrane (segmental membrane‡) from which arises, in the vast majority of species, three appendages, viz., a median organ, the ædeagus, and a pair of genital styles or parameres. Between the bases of the genital styles the segmental membrane is sclerotized, the sclerite

* Compare with the ovipositor of *Microgaster* (Hymenoptera), where the dorsal vulvulæ are some distance from the ventral; this condition is found in many other ovipositors.

† Trans. Ent. Soc. London, 1925, pp. 127–267, figs. 1–280.

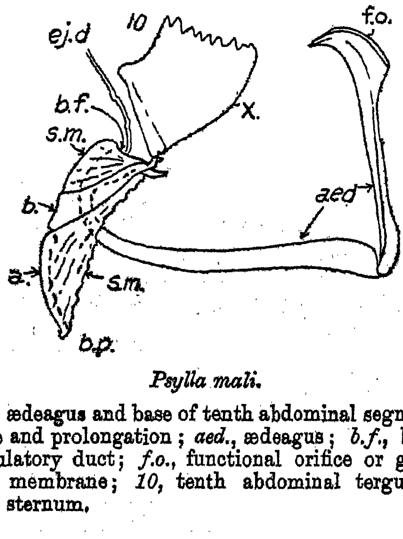
‡ Genital membrane, short for membrane of genital area, would be a better term.

being termed by Singh-Pruthi the basal plate. This gives attachment to muscles which work the genital styles and ædeagus.

In the majority of Cercopidæ we find no basal plate; the base of the ædeagus is enlarged, and the genital styles are in contact with it or very near by. In his figure of *Machærota ensifera*, Singh-Pruthi marks a small area "*bp*," but makes no use of it in his description.

In the Jassidæ we find the basal plate in a very simple form as a small sclerite between the bases of the genital styles. In *Eurymela* it has a small flange-like apodeme projecting into the lumen of the pygofer, which is of interest when we consider the Fulgoroidea. In the more specialized

Fig. 3.



Psylla mali.

Lateral view of ædeagus and base of tenth abdominal segment. *a.* and *b.*, basal plate and prolongation; *aed.*, ædeagus; *b.f.*, basal foramen; *ej.d.*, ejaculatory duct; *f.o.*, functional orifice or gonopore; *s.m.*, segmental membrane; *10*, tenth abdominal tergum; X., tenth abdominal sternum.

Jassidæ we find the development of the basal plate prolongation as a narrow sclerite, or continuation of the basal plate, towards the base of the ædeagus. A further specialization is the joining of the basal plate, basal plate prolongation, and the base of the ædeagus into a single sclerite. This is developed into a complex structure in many forms.

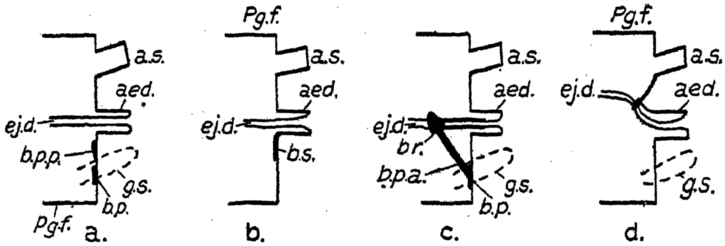
In the Membracidæ the basal plate is present, but very small, and similar to that found in the more generalized Jassidæ.

In *Tettigareta*, the one genus of Cicadidæ in which genital styles are present, the basal plate is large and complex. In

all the others there are neither genital styles nor basal plate, but we find the sclerotization of the ædeagus extended on to the segmental membrane as two narrow strips. The genus *Tettigarcta*, which constitutes a distinct subfamily by itself, differs from all other genera of Cicadidæ by possessing no sound-producing organ in the male.

Elsewhere I have stated that the Cercopidæ appear to be the most generalized of the Cicadoidea, and it is also probable that the absence of a basal plate is also a generalized character. If that be so, then we can use (with discretion) the development of the basal plate and prolongation to show the line of evolution. The loss of the basal plate along with the genital styles is a secondary specialization.

Fig. 4.



Diagrammatical representation of the two types of male genitalia. *a*, the normal Cicadoidian type; *b*, variation found in most Cicadidæ; *c*, the Fulgoroidian type; *d*, variation found in Derbidæ; *aed.*, ædeagus; *a.s.*, anal segment; *b.p.*, basal plate; *b.p.a.*, basal plate apodeme; *b.p.p.*, basal plate prolongation; *br.*, bridge; *b.s.*, basal strut; *ej.d.*, ejaculatory duct; *g.s.*, genital style; *Pg.f.*, pygofer.

In all the families mentioned above the basal plate and the basal plate prolongation are external sclerites, or sclerotizations of the segmental membrane, and only in a few forms (i.e., *Eurymela*) is there a very small apodeme formed. This we can consider as a characterization of the Cicadoidea (fig. 4, *a*).

When we turn to the Fulgoroidea we find a very different arrangement, which is in contrast to the above (fig. 4, *b*). The basal plate is small and situated between the bases of the genital styles; it gives rise to a large invagination or apodeme which protrudes into the cavity of the pygofer and meets the ejaculatory duct as it leaves the ædeagus, and forms therewith a structure which Singh-Pruthi terms the basal plate bridge. This structure is complex and large, and gives attachment to the muscles which work the genital styles and the ædeagus. This type of basal plate and apodeme is

peculiar to the Fulgoroidea, and I have found it in no other Homoptera.

Singh-Pruthi calls the sclerite in the Cicadoidea and the apodeme in the Fulgoroidea the basal plate prolongation, and speaks of them as homologous. This I cannot agree with; if the former is called the basal plate prolongation, then the latter should be the basal plate apodeme. The homology of the apodeme in Fulgoroidea is found in the Cicadoidea in the small apodeme in such forms as *Eurymela*.

In the Cicadoidea we find a modification by reduction in the Cicadidæ, so in the Fulgoroidea we find a modification by reduction in the Derbidæ. In this family Singh-Pruthi figures a slender basal plate apodeme, but I have not been able to distinguish it. If it be present it is rudimentary. In some species there is a minute invagination between the bases of the genital styles. In its place we find an extension of the sclerotization of the ædeagus on to the segmental membrane to meet the base of the tenth abdominal sternite. In some genera (i. e., *Mysidia*) this forms an invagination which, in conjunction with the ejaculatory duct, gives attachment to muscles (fig. 4, *d*). Another character in which this family differs from other fulgorids is found in the ninth abdominal tergite, which is not amalgamated to the rest of the pygofer, but is consolidated to the anal segment.

If we examine the male genitalia of one of the Psyllidæ (i. e., *Psylla mali*) we find that the ædeagus is long, slender, with a joint about the middle and the base swollen (fig. 3, *aed.*). It arises from the segmental membrane (*s.m.*) near the base of the anal segment (X.). The basal plate and prolongation are formed of two sclerites, one (*a*) starting from between the bases of the genital styles forms a narrow band and meets a larger sclerite (*b*) which nearly surrounds the base of the ædeagus. Thus we see that this structure is similar to that found in the Cicadoidea, viz., a sclerotization of the segmental membrane without any invagination to form an apodeme; any connection it has with the ædeagus is with its base. We thus see that we cannot place the Psyllidæ near to the Fulgoroidea, as they have the typical Cicadoidea type of male genitalia.

It is unfortunate that the Homoptera have been divided into Sternorhyncha and Auchenorhyncha, as the Cicadoidea have closer affinities with the Sternorhyncha than with the Fulgoroidea, both in the structures of the male genitalia and the head. The Psyllidæ must remain in the Sternorhyncha along with the other three families (or superfamilies); they

represent a specialization (considerably by reduction) of the Cicadoidea. The latter should form a distinct group apart from the Fulgoroidea, and the grouping of them together under the term Auchenorhynchi should be abandoned *.

One of the greatest needs in systematic entomology to-day is an increase of knowledge of morphology. Not only is our knowledge of this subject along many lines very limited, but the use made by many systematists of the knowledge we possess is very poor.

LIV.—*On the Association of a Gymnoblastic Hydroid* (Zanclea protecta, *sp. n.*) *with various Cheilostomatous Polyzoa from the Tropical E. Pacific.* By Anna B. Hastings, M.A., Ph.D.

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These specimens form part of the collection of Polyzoa made by Dr. C. Crossland on the cruise of the S.Y. 'St. George' (Hastings, 1930).

Only the Hydroid phase is represented in the collection, but the peculiarities of its association with the Polyzoa seem to deserve attention. In order to describe this relationship a systematic description of the Hydroid has had to be attempted, although it is of necessity incomplete. I am much indebted to Capt. A. Knyvett Totton, M.C., for his help in my work on the Hydroid.

Zanclea protecta, sp. n. (Figs. 1–6.)

Occurrence.—On various Polyzoa.

Taboga 1, 1–2 fms., broken coral.

Gorgona 3, 15 fms., shells, dead coral, and gravel.

Galapagos 1, James Is., James Bay, 5–6 fms., clean sand and plenty of weed.

Type.—On part of the type-material of *Smittina crosslandi*, Hastings (B.M. 29.9.14.2), from Taboga 1.

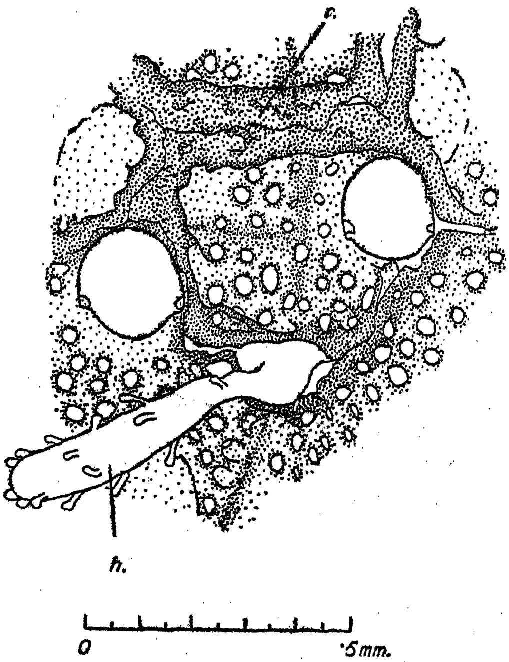
Description.—The hydrorhiza is fine and branched. It creeps on the Polyzoa, usually following the interzoœcial grooves (fig. 2), and may be enclosed in a calcareous tube formed by the Polyzoa (figs. 1 & 5) or imbedded between the lateral walls of the zoœcia.

The hydranths arise singly from the hydrorhiza. From 12 to 20 small, slightly knobbed tentacles are scattered over the greater part of the hydranth. They are solid, having a single row of broad, flat, endoderm cells. The largest tentacles are distal, and

* Mr. W. E. China agrees with me in this matter, and we suggest the names Trepomera for the Cicadoidea and Akinetomera for the Fulgoroidea, founded upon the nature of the hind coxæ.

they are progressively smaller and more sparsely scattered proximally. In incompletely expanded hydranths the proximal ones are little more than lumps on the surface (fig. 3, A & B). Well-expanded hydranths occasionally show traces of a spiral arrangement of the tentacles in four series, and when much contracted they appear to have a more or less terminal cluster of tentacles (fig. 2). The hydrocaulus is very short and is only distinguished

Fig. 1.



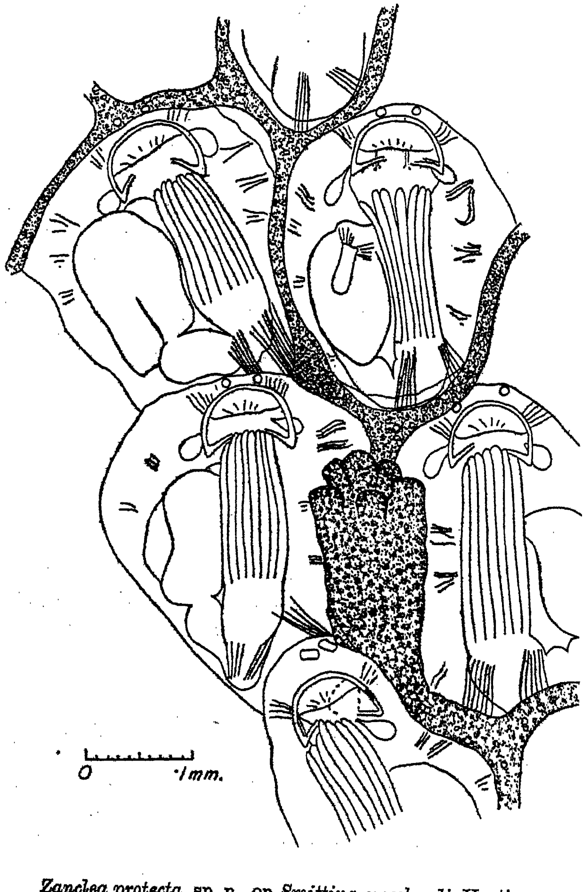
Zanclea protecta, sp. n., on *Hippodiplosia pertusa* (Esper).
Hydrorhiza enclosed in calcareous tube and hydranth projecting through a gap in the tube. *h.*, hydranth; *r.*, hydrorhiza in tube.

by the absence of tentacles; a branch of the hydrorhiza sometimes arises from it. The length of the hydranth from its tip to the base of the hydrocaulus, when well extended, is ·3–·9 mm.

There are nematocysts in the knobs of the tentacles and scattered in the body-wall and in the hydrorhiza (fig. 6, B). Their sac measures ·009 × ·007 mm. before extrusion of the thread. One smaller nematocyst ·004 mm. wide, after extrusion, was seen (fig. 3, B). The thread is expanded proximally and bears four barbs.

The medusa buds are borne in groups of two or three on branched stalks arising directly from the hydrorhiza (fig. 4). One medusa bud is nearly ready for liberation (fig. 4, B). A mass, which has been interpreted as a partly expanded tentacle, projects from the

Fig. 2.



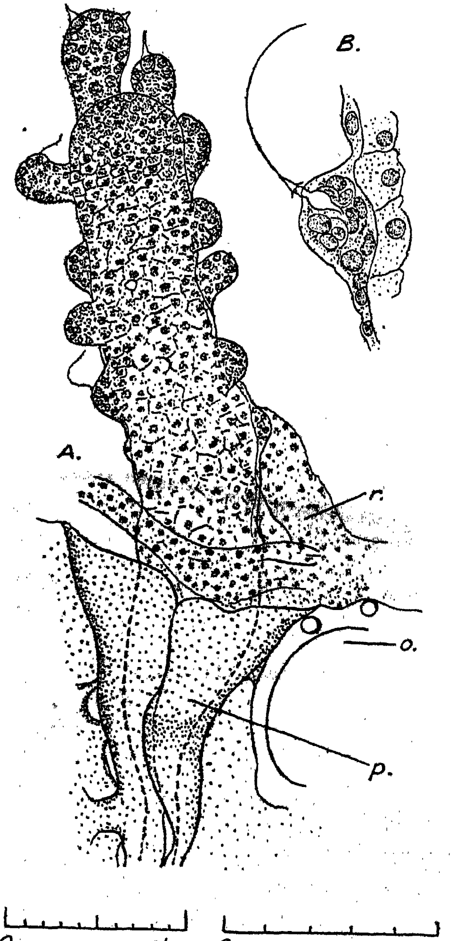
Zanclea protecta, sp. n., on *Smittina crosslandi*, Hastings.

Decalcified specimen. Hydrorhiza following interzoœcial lines. Hydranth much contracted.

bell at one side, and on the other there is a corresponding mass still packed away. The everted tentacle is surrounded by a cluster of spherical bodies. Although nematocysts cannot be distinguished in them, it seems possible that they are the stalked organs

characteristic of the tentacles of *Gemmaria* and *Zanclea*. A few nematocysts can be seen in the ectoderm of the bell at the base of the incurved mass (tentacle?). In the less-developed gonophores

Fig. 3.



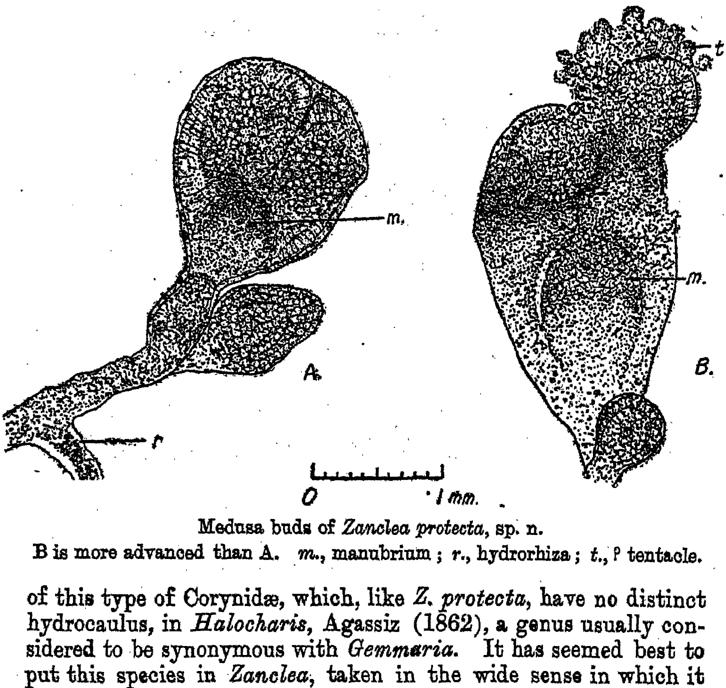
Zanclea protecta, sp. n., on *Smittina crosslandi*, Hastings.
A. Partially expanded hydranth projecting from broken edge of Polyzoan. Base of calcareous pocket intact. B. Optical section of a proximal tentacle. *o.*, orifice of Polyzoan; *p.*, calcareous pocket; *r.*, hydrorhiza.

there are nematocysts more generally distributed in the ectoderm. The gonads have not been detected.

Sections show traces of a fine chitinous lamina between the hydroid tissue and the wall of the Polyzoan. It is not continued beyond the base of the hydranth. It is presumably a perisarc, but is exceedingly delicate.

Remarks.—This Hydroid is clearly one of the Corynidæ, but without the medusa the generic determination is bound to be somewhat speculative. The evidence, such as it is, of the advanced medusa bud described above points to *Zanclea* or *Gemmaria*, and the characteristics of the hydroid stage support this conclusion. Without the mature medusa it is not possible to distinguish between these genera, and some authors have continued to regard them as synonymous *. Stechow (1922, p. 143) puts the species

Fig. 4.



Medusa buds of *Zanclea protecta*, sp. n.
B is more advanced than A. *m.*, manubrium; *r.*, hydrorhiza; *t.*, ? tentacle.

of this type of Corynidæ, which, like *Z. protecta*, have no distinct hydrocaulus, in *Halocharis*, Agassiz (1862), a genus usually considered to be synonymous with *Gemmaria*. It has seemed best to put this species in *Zanclea*, taken in the wide sense in which it includes *Gemmaria* and *Halocharis* as synonyms.

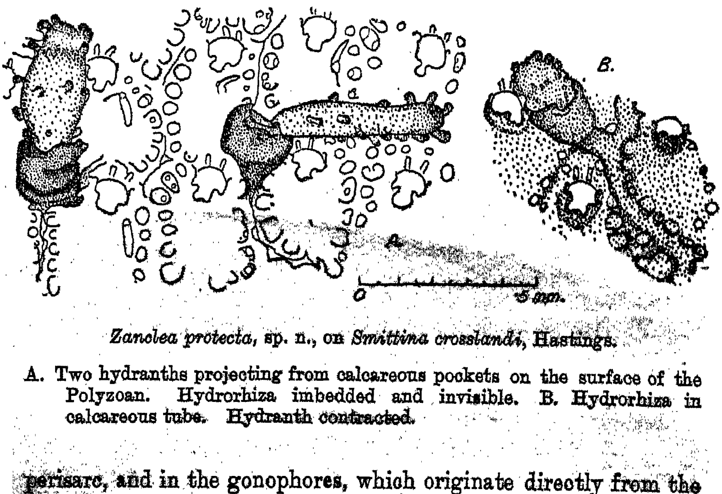
The species is very near *Coryne* vel *Syncoryne cylindrica*, Kirkpatrick (1890, p. 605), found on the Polyzoan *Cellepora granulosa* from Torres Straits. It differs in the weaker development of the perisarc. The hydranths seem to be similar in form

* Mayer (1910, p. 85) and others regard *Zanclea*, Gegenbauer (1856, p. 229), *Gemmaria*, McCrady (1859, p. 151), and *Halocharis*, Agassiz (1862, [illegible]), as synonymous. Other authors treat them as distinct, *e. g.*, Hargitt [illegible] (1914, p. 497), and Stechow (1919, p. 153).

and dimensions, but the type-material is very unsatisfactory, consisting of microscopic preparations of a few fragments bearing much contracted hydranths, like that in fig. 2. The Polyzoan bearing the unmounted material has been dried, and the hydranths are no longer discernible. The network of the hydrorhiza can still be detected, chiefly on the frontal surface, but also on the basal. Owing to the state of the material, it has been impossible to determine whether its relations to the Polyzoan are similar to those of *Z. protecta.* Kirkpatrick's species was transferred to *Halocharis* by Stechow (1922, p. 143).

Z. protecta differs from the other known species of *Zanclea*, *Gemmaria*, and *Halocharis* in the smaller number of shorter, relatively thicker tentacles, the very slight development of the

Fig. 5.



Zanclea protecta, sp. n., on *Smittina crosslandi*, Hastings.

A. Two hydranths projecting from calcareous pockets on the surface of the Polyzoan. Hydrorhiza imbedded and invisible. B. Hydrorhiza in calcareous tube. Hydranth contracted.

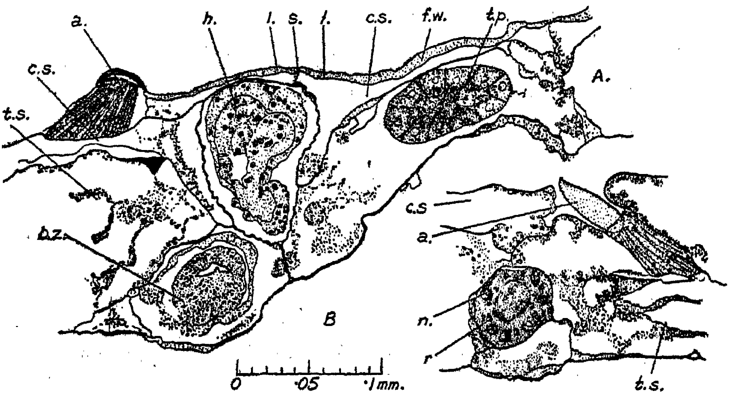
perisarc, and in the gonophores, which originate directly from the hydrorhiza—not from the hydranth. It differs from all except *Halocharis minuta*, Stechow (1925, p. 519), in its small size. Stechow's species has a larger number of tentacles, and they are confined to the distal half of the hydranth.

Records of these genera in the Pacific are not numerous. The following may be mentioned :—The Hydroid stage of a species of *Gemmaria* was described from Juan Fernandez by Hartlaub (1905, p. 527, *G. nitida*), and a medusa from Acalpulco Harbour by Bigelow (1909, p. 188, *Zanclea gemmosa*), who thinks it may be the medusoid stage of *G. nitida*. From Japan, Stechow (1909, p. 34) records *Gemmaria gemmosa*, and Uchida (1925, p. 80) describes a medusa, *Zanclea maasi*. Hartlaub's Hydroid from Juan Fernandez differs from *Z. protecta* in its greater size, the larger number of tentacles, and the position of the gonophores.

Relation of the Hydroid to the Polyzoa.

Zanclea protecta has been found on the following Cheilostomatous Polyzoa:—*Smittina crosslandi*, Hastings, *Hippodiplosia pertusa* (Esper), *Rhynchozoon rostratum* (Busk), *Smittina trispinosa* (Johnston), and *Hippoporella gorgonensis*, Hastings. The colony on *H. pertusa* is colourless, the others are brown. The hydrorhiza is more or less deeply imbedded in the Polyzoan. It may run between the lateral walls of the zoœcia (fig. 6, B) or in a slightly projecting calcareous tube continuous with the frontal wall of the Polyzoa (figs. 1 & 5, B). The tube is formed by a pair of calcareous laminæ which grow from the frontal wall and meet. The suture can sometimes be seen in whole mounts, and it is very clear in sections (figs. 1, 5, A, & 6, A). The hydrorhiza is thus well protected by the Polyzoa, though always morphologically external.

Fig. 6.



Zanclea protecta, sp. n., on *Smittina crosslandi*, Hastings.

A. Slightly oblique transverse section of *S. crosslandi* through base of a hydranth of *Z. protecta*. B. Similar section, showing rather thick hydrorhiza imbedded between the lateral walls and containing nematocysts. *a.*, avicularium; *b.z.*, base of anterior zoœcium; *c.s.*, compensation sac; *f.w.*, frontal wall; *h.*, hydranth; *l.*, lamina; *n.*, nematocyst; *r.*, hydrorhiza; *s.*, suture; *t.p.*, polyzoan tentacles; *t.s.*, tentacle sheath.

In the region of the hydranth the tube widens and the laminæ do not meet, thus leaving a gap in the roof of the tube through which the hydranth emerges and stands erect (fig. 1). In *Smittina crosslandi* there is a further modification of the Polyzoan, for the laminæ grow up and form a pocket which protects the hydranth or gonophore (fig. 5, A & B). There is no evidence that the pocket is formed by growth of Polyzoan tissue over a cup of Hydroid perisarc. No such cup is to be seen in the specimens without calcareous pockets, and, though sections show traces of

perisarc round the hydrorhiza, they show none round the hydranth. The pocket, therefore, presumably originates entirely from the Polyzoan. Specimens of the Polyzoa without the Hydroid show none of these modifications.

Examples of Hydroids associated in various degrees of intimacy with other animals are not uncommon, see Alcock (1892), Calman (1911), Jungersen (1913), and Caullery (1922). The recorded associations with Polyzoa appear, with the possible exception of *Halocharis cylindrica* (Kirkpatrick), mentioned above, to be of a somewhat casual type, e.g., *Hydranthea margarica* found by Hincks (1868, p. 100) on *Flustra foliacea*, and *Gemmaria gemmosa* found on various Polyzoa at Wood's Hole (Murbach, 1899, p. 354, as *Corynitis agassizii*, McCrady *). The association of *Z. protecta* is more definite in that the Polyzoa are modified, and the Hydroid presumably benefits thereby. The Polyzoa can all thrive independently of the Hydroid, and it seems improbable that they derive any advantage from the presence of *Zanclea*. The relationship is thus to be described as one of synœcy rather than mutualism or commensalism.

LITERATURE.

AGASSIZ, L. 1862. 'Contributions to the Natural History of the United States of America.'—IV. Boston.

ALCOCK, A. 1892. "On a Case of Commensalism between a Gymnoblastic Anthomedusoid (*Stylactis minoi*) and a Scorpænid Fish (*Minous inermis*)." Ann. & Mag. Nat. Hist. (6) x. pp. 207–214, 1 text-fig.

BIGELOW, H. B. 1909. "Reports of the Scientific Results of the Expedition to the Eastern Tropical Pacific . . . by the U.S. Fish Commission Steamer 'Albatross.'—XVI. The Medusæ." Mem. Mus. Comp. Zool. Cambridge, Mass. xxxvii. pp. 1–243, 48 pls.

BRÜCKNER, E. 1914. "Beitrag zur Kenntnis von *Perigonimus cidaritis*, Weismann, und *Gemmaria implexa*, var. *neapolitana*, Hargitt." Z. wiss. Zool. Leipzig, cxi. pp. 445–505, 9 pls., 24 text-figs.

CALMAN, W. T. 1911. "An Epizoic Hydroid on a Crab from Christmas Island." Ann. & Mag. Nat. Hist. (8) viii. pp. 546–550, 2 text-figs.

CAULLERY, M. 1922. 'Le Parasitisme et la Symbiose.' Paris.

GEGENBAUR, C. 1856. "Versuch eines Systemes der Medusen mit Beschreibung neuer oder wenig gekannter Formen . . ." Z. wiss. Zool. Leipzig, viii. pp. 202–273, 4 pls.

HARGITT, C. W. 1908. "Notes on a few Cœlenterates of Wood's Holl." Biol. Bull. xiv. pp. 95–126, 17 text-figs.

HARTLAUB, C. 1905. "Die Hydroiden der magalhaenischen Region und chilenischen Küste." Zool. Jahrb. Jena, Suppl. vi., Fauna Chilensis, iii. pp. 497–714, 141 text-figs.

HASTINGS, A. B. 1930. "Cheilostomatous Polyzoa from the Vicinity of the Panama Canal . . ." Proc. Zool. Soc. London, 1929, pp. 697–740, 17 pls., 1 text-fig.

HINCKS, T. 1868. 'A History of the British Hydroid Zoophytes.' 2 vols., London.

JUNGERSEN, H. F. E. 1913. "On a new Gymnoblastic Hydroid (*Ichthyocodium sarcotretis*) epizoic on a new parasitic Copepod . . ." Vidensk. Medd. naturh. Foren. Kjøb. lxiv. pp. 1–33, 2 pls.

* Hargitt, 1908, pp. 100–106; Stechow, 1909, p. 34.

Kirkpatrick, R. 1890. "Reports on the Zool. Collections made in Torres Straits by Prof. A. C. Haddon, 1888–1889.—Hydroida and Polyzoa." Proc. Roy. Dubl. Soc. n.s. vi. pp. 603–626, 4 pls.

Mayer, A. G. 1910. "Medusæ of the World.—I. Hydromedusæ." Pub. Carn. Inst. Wash. 109, i. pp. 1–230, 29 pls.

McCrady, J. 1859. "Gymnophthalmata of Charleston Harbour." Proc. Elliott Soc. Nat. Hist. Charleston, i. pp. 103–221, 4 pls.

Murbach, L. 1899. "Hydroids from Wood's Holl. Mass." Quart. J. Micr. Sci. London, xlii. pt. 3, pp. 341–360.

Stechow, 1909. "Hydroidpolypen der japanische Ostküste.—I. Athecata und Plumularidæ." Abh. bayer. Akad. Wiss. 1 Suppl.-Bd. Abh. 6, pp. 1–111, 7 pls. 8 text-figs.

——. 1919. "Zur Kenntnis der Hydroidenfauna des Mittelmeeres, Amerika und anderer Gebiete . . ." Zool. Jahrb. Jena Syst. xlii. pp. 1–172, 56

——. 1922. "Zur Systematik der Hydrozoen." Arch. Naturgesch. Berlin, lxxxviii. Abt. A, Heft 3, pp. 141–155.

——. 1925. "Die Hydroidenfauna des Afrikanischen Atlantik . . ." Deutsche Tiefsee-Expedition 1898–99, Jena, xvii. Heft 3, pp. 387–546, 54 text-figs.

Uchida, T. 1925. "Hydromedusæ from Northern Japan." Jap. J. Zool. Tokyo, i. no. 3, pp. 77–100, 19 text-figs.

LV.—*A new Hippoboscid Parasite (Diptera Pupipara) of the Indian Sand-Martin.* By Major E. E. Austen, D.S.O.

Family Hippoboscidæ.

Genus Ornithomyia, Latreille.

Ornithomyia comesa, sp. n.

♂ ♀.—Length, ♂ (six *dried* specimens) just over 3 mm. to 4 mm., ♀ (six *dried* specimens) 3·6 to 4·6 mm.; width of head, ♂ 1·2 to 1·25 mm., ♀ 1·25 to 1·4 mm.; length of wing, ♂ 4·8 to 5 mm., ♀ 4·6 to 5·2 mm.

General coloration (dried specimens):—*upper surface of head ochraceous-buff* *, *or ochraceous-tawny, to mummy-brown (frontal stripe russet- or mummy-brown), dorsum of thorax mummy-brown to blackish brown; wings with a strong, uniform, blackish tinge; legs light brownish olive to brownish olive.—Head in both sexes, viewed from above and exclusive of clypeus, antennary prolongations, and mouth-parts, practically circular in outline (much more nearly circular than that of* O. avicularia, *Linn., in which transverse diameter is the longer); dorsal surface of scutellum clothed with erect hair*

* For names and illustrations of colours used for descriptive purposes in the present paper, *see* Ridgway, 'Color Standards and Color Nomenclature' (Washington, D.C., published by the Author, 1912).

from base to beyond middle of disc; distal half of abdomen, especially at and towards sides, and antero-superior surfaces of femora conspicuously hairy.

Head: vertical triangle more nearly equilateral (less wide at base) than in *O. avicularia*, Linn., and rows of hairs fringing inner margins of orbits approaching a shade nearer to its apex than in latter species. *Thorax*: anterior half of dorsal surface of scutellum much more hairy than in *O. avicularia*: hair, as elsewhere on body and on legs, black. *Abdomen*: plates of chitin in middle line on upper surface in ♀, in front of apical plates, usually conspicuous and clearly defined. *Wings*: terminal section of thickened portion of costa often only half as long as penultimate section, occasionally more than half as long, but sometimes even less (shorter on the whole than in *O. avicularia*).

India: Bihar, Pusa, 17.ii.–7.iv.1923, on nestlings of the Indian Sand-Martin (*Riparia paludicola chinensis*, Gray and Hardwicke). Collected by — *Shaffi*: presented by Mr. T. Bainbrigge Fletcher; thirty-four specimens (seventeen ♂ ♂, seventeen ♀ ♀) in all.

Type of ♂, type of ♀, and a series of paratypes of both sexes in British Museum (Natural History); a further series of paratypes in the Agricultural Research Institute, Pusa.

So far at least as it is possible to judge from the description, *O. comosa* would seem to be allied to *O. javana*, Jænnicke (Abhandl. Senckenb. naturf. Ges., Bd. vi. p. 406, Taf. xliv. fig. 14, 1867), of Java, the host of which is unknown. *O. javana*, however, would appear to be considerably larger (length 6 mm. instead of at most 4·6 mm.) and to have the upper margin of the antennæ edged with black.

LVI.—*Second Species of the Palæarctic Genus* Podisma (*Orthoptera*, Acrididæ) *found in Assam*. By B. P. Uvarov.

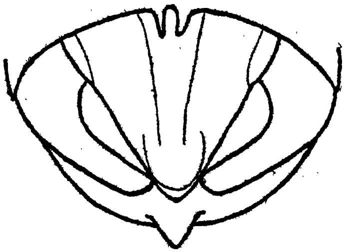
Some time ago I described a new species of the genus *Podisma* discovered by F. Kingdon Ward in Assam, and discussed the zoogeographical importance of that discovery *. The fact that the same naturalist has found, on his 1928 expedition to Assam, another species of the same genus contributes further evidence of the former southern limit of Palæarctic fauna, or, to be more exact, of its Angara elements.

* "*Podisma kingdoni*, sp. n.: a Contribution to the Zoogeography of the Himalayas," Ann. & Mag. Nat. Hist. ser. 9, vol. xx. 1927, pp. 481–484, 1 fig.

Podisma assama, sp. n.

♂ (*type*).—Fairly large in size, slenderly built, approaching in the general appearance such species as *P. schmidti*, Fieb., and *P. salamandra*, Fisch.

Antennæ in the type incomplete, but clearly longer than head and pronotum together. Face strongly oblique. Frontal ridge in profile distinctly rounded-prominent between the antennæ, slightly concave lower down; its surface strongly punctured, feebly sulcate below the ocellum; margins obtuse, more or less parallel throughout. Fastigium of vertex well projecting forward, deeply sulcate, but with the margins obtuse, little divergent in front. Eyes



Podisma assama, sp. n., ♂. End of abdomen.

large, strongly projecting sideways; subocular distance subequal to the horizontal diameter of an eye; interocular distance scarcely broader than the frontal ridge between antennæ.

Pronotum relatively long, cylindrical, not at all flattened above, coarsely rugose above, less so on the lateral lobes. Anterior margin somewhat reflexed, rounded, broadly and shallowly sinuate in the middle; posterior margin shallowly excised. Transverse sulci very deep and broad; metazona half the length of prozona. Lateral lobes distinctly longer than high, between the sulci smooth and shining, with a few scattered punctures, elsewhere rugulose; lower margin rounded-prominent. Median keel scarcely perceptible in front of the first sulcus and behind the last. Mesonotum not entirely covered by the pronotum. Metanotum and the first tergite rugose and punctured, with a low median keel. Prosternal tubercle conical. Mesosternal interspace narrower than one of the lobes. Metasternal interspace moderately narrow.

Tympanal organ small.

Elytra absent.

[illegible] cylindrical, very slightly incrassate towards the

apex. Second tergite distinctly, if minutely, punctured; third with a few scattered punctures. Last tergite with a pair of narrow appendages in the middle. Supra-anal plate triangular, with rounded apex; a shallow sulcus runs along the raised median part, widening basally, and again rather suddenly, near the apex; lateral margins incrassate near the base, where elongate sublateral tubercles are formed. Cerci stout, blunt, strongly incurved, not extending behind the supra-anal plate. Subgenital plate small, with the apex attenuate and rounded.

General coloration very dark olivaceous, shiny. Lateral black fasciæ on the head, pronotal lobes, and abdomen scarcely perceptible owing to the general colour being very dark. Hind femur reddish, with a pale preapical ring and black knee; externomedian area with two large blackish spots, not sharply defined. Hind tibia dirty greenish blue, with the base black, followed by a pale ring; spines wholly black.

♀ (*paratype*).—More robust and considerably less rugose than the male. Frontal ridge in profile strongly rounded-prominent between the antennæ and concave below them; its surface strongly punctured, deeply sulcate below the ocellum. Fastigium of vertex strongly projecting in front of the eyes, distinctly sulcate, elongate-oval. Pronotum distinctly conical, rugulose. Mesonotum and metanotum very slightly rugulose. Upper valvæ of the ovipositor fairly long, moderately stout; lower valvæ long, pointed, with a small but acute tooth.

Length of body, ♂ 23, ♀ 26; pronotum, ♂ 5, ♀ 5·5; hind femur, ♂ 12, ♀ 13 mm.

Described from two males and four females taken at the Delei Valley, N.E. Assam, 26. iii., alt. 2000 feet (1 ♂, type); 23. iii., alt. 2000 feet (1 ♂); 17. iii., alt. 4000 feet (1 ♂, 1 ♀); 6. vi., alt. 10,000 feet (1 ♀); 10. vi., alt. 12,000 feet (1 ♀).

According to the information supplied by Mr. Kingdon Ward, this grasshopper was very abundant on the alpine meadows (12,000 feet), on clearings in the *Abies* and *Rhododendron* forest (10,000 feet), as well as in the cultivated zone (2000–4000 feet).

The new species differs considerably from *P. kingdoni*, Uv., by the structure of the head, less rough sculpture of the body, absence of elytra, and the structure of both male and female genitalia, as well as by the more slender stature, while both species have the same type of general coloration. Strongly oblique face and prominent fastigium separate *P. assama* from other known species of the group.

LVII.—*The Breeding-season of* 1929 *in N. Cornwall.* By Lt.-Col. B. H. Ryves.

With reference to the Report on the effect of severe weather in 1929 on Bird-life ('British Birds,' *antea*, pp. 155–158), it may be of interest to survey the climatic conditions that succeeded, in April, May, and June, the severe frosts of February and March, and to examine what effect the combination of these conditions has had on fecundity and breeding generally.

I am in a position to deal with the subject only so far as it concerns my own district of Mawgan-in Pydar, North Cornwall. Although the severe weather of the early spring had but a trivial effect upon mortality in bird-life, yet, undoubtedly, birds must have suffered malnutrition.

April was characterized by conditions highly unfavourable to breeding. Cutting northerly to easterly winds, with no rainfall, prevailed practically throughout the month. On the 5th there was a temporary respite, and between the 15th and 19th a rise in temperature occurred, with some warm sunshine. From the 20th to 25th the winds became almost arctic, and sharp frosts were registered on four successive nights. A little drizzle and a refreshing shower of rain fell between the 27th and 29th.

May opened with similar cold and dry conditions. On the 3rd, after ground-frost, the temperature rose slightly and a little rain fell. The 9th was a day of softness and sunshine. Otherwise, until the evening of the 16th, there was a succession of strong southerly to north-westerly gales, accompanied by heavy rains and occasional hail. From the 17th to the end of the month the weather was mild, with a considerable amount of sunshine and a few soft showers.

June was mainly mild, and much rain fell until the 15th. The remainder of the month was entirely dry, hot, and sunny, except for rain on the 30th.

A consideration of the above summary shows that conditions for breeding were distinctly unfavourable until the second half of May. This resulted in April, which is normally a month of considerable activity, being marked by an almost complete postponement of nesting operations. Those birds that had been induced to breed by the rise in temperature in the latter part of March succeeded, in some cases, in rearing their young, but in others nestlings or fledglings died.

The main result of the lateness of the season, combined presumably with the deleterious weather that preceded it,

was the apparent failure of even blackbirds and song-thrushes to rear more than two broods. But in this connection it seems difficult to determine to what extent the drought and heat-wave of later June and almost the whole of July were responsible for this failure. In each of the examples of blackbirds given in the table there was still plenty of time, for usually third broods are not fledged until the third or fourth week of July. A fair proportion of gold-finches and greenfinches reared two broods; but I recorded no third broods definitely, and such records have not been unusual in past seasons. These latter birds were further handicapped by the heavy rain that fell for twenty consecutive hours on August 3rd. Those that were incubating or feeding small nestlings were forced to desert; but one bird at least (a goldfinch) re-nested, and young were fledged in the second week of September. This unseasonable rainfall is possibly one of the contributory factors to account for the general paucity of partridges in the district this season. Many of these birds laid very late clutches.

Although, in 1917, smaller clutches of eggs were noted by several observers, a perusal of the table will show that this does not appear to have been the case here in 1929.

A point worth noting, perhaps, is that some of the smaller species, notably great tits, blue tits, chaffinches, and hedge-sparrows, which commenced incubation in April or early May, failed either to hatch their full clutches or to rear the whole brood. I formed the opinion that there was a rather larger percentage of addled eggs than is normal. Further, I noticed but few full-sized broods on the wing of the tit family or of chaffinches. Ground-nesting species—larks, pipits, and corn-buntings—made good their earlier failures during the dry and hot weather of June and July.

The larger birds appear to have been unaffected by the severe conditions. Of seven buzzards' nests each pair reared two or three young, and the broods of four pairs of ravens were safely fledged. Gulls and shags laid normal clutches and reared normal broods; but a pair of dippers (a rare species in the district), whose first brood was fledged on April 30th, made no attempt to nest again.

The general conclusion I have formed by observations throughout the breeding-season of 1929 is that the output of the larger species of birds has been about normal, but that of many resident species (the size of the mistle-thrush and smaller) has been about 30 per cent. below the probable average figure covered by a period of years.

Table of Clutches.—1929.

Species.	No. of eggs in clutch.	Incubation commenced on.	No. of Eggs hatched—and date.	No. of young fledged—and date.	Remarks.
Blackbird (*Turdus m. merula*) ..	....	26th March	— 9th April	3 on 22nd April	Same nest.
do.	....	3rd May	— 16th May	Nil.	Young died on 16th May.
do.	4	22nd May	4 on 4th June	4 on 17th June	New nest. Nesting ceased.
Blackbird	4	28th March	4 on 10th April	4 on 25th April	Same nest.
do.	4	6th May	4 on 19th May	4 on 2nd June	Nesting ceased.
Blackbird......	4	30th March	4 on 13th April	4 on 27th April	Same nest.
do.	5*	16th May	5 on 29th May	5 on 10th June	Nesting ceased.
Blackbird	4	1st April	4 on 14th April	4 on 28th April	Same nest.
do.	4	10th May	4 on 23rd May	4 on 5th June	Nesting ceased.
Song-Thrush (*T. ph. clarkei*) ..	5	26th March	4 on 8th April	Nil.	Young died in nest on 14th April.
do.	4	28th March	3 on 11th April	3 on 25th April	
do.	4	23rd April	3 on 6th May	3 on 21st May	
do.	5	11th May	5 on 24th May	5 on 7th June	
do.	4	7th June	4 on 20th June	4 on 3rd July	
Hedge-Sparrow (*Prunella m. occidentalis*)	3	30th April	2 on 14th May	1 on 28th May	One young died in nest.
do.	4	13th April	4 on 28th April	4 on 14th May	Nest very sheltered.
do.	4	1st May	4 on 15th May	1 on 28th May	Three young died in nest.

Robin (*Erithacus r. melophilus*)	5	8th April	5 on 22nd April	Nil.	Young died in nest on 27th April.
{ do.	5	1st May	4 on 15th May	Nil.	Young died in nest on 15th May.
{ do.	5	7th June	5 on 21st June	5 on 4th July	
Chaffinch (*Fringilla c. cœlebs*) ..	4	....	2 on —	2 on 26th May	
do.	4	....	2 on —	Nil.	Young died in nest on 5th June.
Blue-Tit (*Parus c. obscurus*)..	7	6th May	7 on 20th May	7 on 9th June	
do.	7	18th May	3 on 1st June	3 on 20th June	Four addled eggs.
Great Tit (*Parus m. newtoni*)..	7	4th May	3 on 19th May	2 on 5th June	Four addled eggs. One young died in nest.
Buzzard (*Buteo b. buteo*) ..	3	....	All three had been hatched by 13th May	2 on 1st July } 1 on 4th July }	Vigorous birds.
Greenfinch (*Chloris ch. chloris*)..	5	17th May	5 on 30th May	5 on 12th June	
do.	5	....	5 on —	5 on 23rd June	
do.	5	15th July	5 on 28th July	5 on 11th August	
Goldfinch (*Carduelius c. britannica*)	....	....	....	— on 1st June	
do.	5	28th May	5 on 10th June	5 on 25th June	
{ do.	....	....	....	....	Deserted during incubation on 3rd August.
{ do.	4	13th August	4 on 25th August	4 on 9th September	

Note.—Birds bracketed under column " species " represent the same pair.

* These eggs were about 25 % smaller than the average. Five strong birds were reared from them.

LVIII.—*Two new Reptiles from Southern Ecuador.* By H. W. PARKER, B.A.

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AMONGST a collection of reptiles and amphibians collected by Professor Clodoveo Carrion, to whom the British Museum is already indebted for the gift of many valuable and interesting specimens, are examples of a species of snake and a lizard which do not appear to have been previously described. They may be known as :—

A. *Bothrops lojana*, sp. n.

Holotype, a male (immature?), number 1930.1.30.1 in the British Museum, from the vicinity of Loja City, Ecuador (2200 metres); collected by Professor Clodoveo Carrion.

Snout broad, flat above, with angular, slightly raised canthus rostralis; eye moderate; rostral as deep as broad, narrower above than beneath; nasal divided; internasals large, transverse, in contact mesially and followed by another pair of transversely enlarged scales which meet on the middle line; canthals much smaller than the internasals; supraoculars smooth, flat, oval, separated by three series of scales, of which the centre one is a much enlarged frontal shield; three præoculars, the upper very large; two postoculars and a large crescentic subocular which is separated from the upper labials by a single series of scales; scales of the head smooth anteriorly, keeled on the occiput and temples. Seven upper labials, of which the second forms the anterior border of the loreal pit, and the last three are enlarged; eight lower labials, the first pair meeting behind the symphysial; a single pair of enlarged chin-shields. Scales of the body strongly keeled, the keel reaching the extremity of each scale, in 23 rows at the middle of the body; ventrals 154; anal entire; subcaudals paired, 40 + 1. Tail not prehensile.

Colour in spirit.—Pale brown above, with a dark, median dorsal, zig-zag band, which in places is broken up into oval insuliform spots; flanks with small, indistinct, darker blotches; a dark streak from the eye to the side of the neck and a few elongate dark markings on the head; outer two rows of scales and outer ends of ventrals with a row of lighter spots, which coalesce on the neck to form a light stripe which is continued along the labials; on the tail a similar stripe is also formed, which sends upwards about eight vertical black-bordered branches to the mid-dorsal line. Belly yellowish, dusted with pale brown; tip of tail brick-red beneath.

Length from snout to vent 418 mm.; tail 70 mm.

Paratype, a young male from the type-locality, in Professor Carrion's collection. The colouring and scutellation of this specimen are essentially as in the type; there are ten lower labials; 149 ventrals and 39+1 caudals; the second upper labial is semidivided below the loreal pit. Length from snout to vent 271 mm.; tail 42 mm.

This new form appears to be intermediate in many respects between *B. picta* (Tschudi) and *B. andiana*, Amaral. It differs from the former in the scutellation of the head, but agrees in colour-pattern, whilst it agrees with the latter in the arrangement of the head-shields, but differs in its colour-pattern; the number of subcaudals (39–40 in males) is lower than in either. The partial subdivision of the second upper labial, shown in the paratype, further suggests affinity with *B. neuwiedii*, Wagler, and it is not improbable that this latter species, known to be exceedingly variable in the lowlands of Brazil *, may be discovered in a variety of local races in the Andean chain.

B. *Macropholidus annectens*, sp. n.

Holotype, a female, number 1930.1.30.2 in the British Museum, from the vicinity of Loja City, Ecuador (2200 metres); collected by Professor Clodoveo Carrion.

Snout obtusely pointed, its length equal to the distance between the posterior corner of the eye and the ear; canthus rostralis angular; loreal region nearly vertical. Fronto-nasal as long as broad, as long as the frontal; no præfrontals; fronto-parietals small, together about as large as the frontal; three large parietals, the median smallest; two moderate lateral, and a smaller median, occipitals; two subequal supra-oculars; four supraciliaries, the anterior largest and in contact with the frontal; nostril between two nasals, not touching the labials; a loreal, a freno-orbital, and a row of small sub-oculars separating the eye from the labials; lower eyelid with a large undivided transparent disc; seven upper labials, the fourth longest and beneath the eye; five lower labials; a median anterior and three pairs of chin-shields, of which the first two pairs are in contact on the middle line. Ear-opening vertically oval, a little larger than the palpebral disc. Scales of the body strongly striated, with a moderately strong median keel, subrhomboidal, imbricate, slightly oblique on the flanks, and with paired apical pits; the scales form uninterrupted transverse series round the middle of the body, each series containing twenty-six scales, including the ventrals; towards

* Amaral, 'A General Consideration of Snake-Poisoning and Observations on Neotropical Pit-Vipers,' Harvard, pp. 56–62 (1925).

the groin and the arm-pit a row of granules and smaller scales is intercalated between the two lower rows of lateral scales, interrupting the regular transverse rows; thirty-nine (39) scales between occiput and sacrum. Two median rows of gulars transversely enlarged; twelve series between the chin-shields and the indistinct collar-fold. Ventrals smooth, in six longitudinal and twenty-five transverse series; a single pair of large preanals. Caudal scales hexagonal, lanceolate, strongly keeled above; smooth, quadrangular beneath, the two median series nearly as broad as long. Digits 5/5, all clawed; limbs slightly overlapping when adpressed. No femoral pores.

Colour in spirit.—Uniform dark olive above; a fine white line from the tip of the snout, along the canthus rostralis and supraciliary edge to the middle of the sides of neck, where it disappears; light grey suffused with orange beneath; preanal region and lower surfaces of the limbs deep orange; throat yellow; chin-shields white.

Length from snout to vent 55 mm.; tip of snout to ear 11 mm.; width of head 7 mm. Tail (regenerated) 73 mm.

Paratypes, a female in Professor Carrion's collection and a juvenile, number 1930.1.30.3, in the British Museum, from the type-locality. Neither of these specimens differs appreciably from the type in general characters. The scale-counts are:—

	Female.	Young.
Longitudinal scale-rows at mid-body	27	26
Transverse scale-rows from occiput to sacrum	39	35
Gulars from chin-shields to collar	12	12
Ventrals, longitudinal	6	6
Ventrals, transverse	26	24
Dimensions:	mm.	mm.
Snout to vent	44	23
Tip of snout to ear	9	6
Width of head	6	4·5
Tail (entire)	101	48

The colour of the upper surfaces is the same as that of the holotype, but beneath there is no trace of the orange or yellow which is so marked in that specimen; the belly is greenish grey, the chin, anal region, and lower surfaces of the limbs white, and the tail beneath is grey, mottled and dotted with darker and lighter.

The generic status of this species calls for comment. It is not referable either to *Macropholidus* or *Pholidobolus* as at present defined, but combines the characters of the two; in the possession of subrhomboidal scales which form uninter-[illegible] transverse rings round the body, the lack of a lateral [illegible], and the presence of an undivided transparent

disc in the lower eyelid it is allied to *Macropholidus*, but the relatively small, subequal, keeled, and striated scales link it with *Pholidobolus*. Rather than create a new genus, however, and thus establish a precedent for the erection of other new monotypic genera for every intermediate species which may be discovered, it seems better to refer it to the already existing genus, to whose species it is most closely allied, at least until our knowledge of these small Teiid lizards is considerably greater.

LIX.—*Further Considerations in regard to the Classification of the Order Thysanoptera.* By RICHARD S. BAGNALL, Hon. D.Sc., F.R.S.E.

A CLOSE examination of the mouth-parts of the Urothripid *Amphibolothrips grassi*, Buffa, recently discovered in numbers in the South of France, demonstrates that the palpi are undoubtedly single-jointed. Although it has been shown that the supposed extra spiracles described by me in *Urothrips paradoxus* were visible in Trybom's material both dorsally and ventrally and could not be regarded as true stigmata, the fact remains that in the structure of the sternum, of the palpi, of the antennæ, and in the chætotaxy, etc., members of the family Urothripidæ (though Tubuliferous in general form) differ strongly from those of both the recognized suborders Terebrantia and Tubulifera; and I can only uphold the erection of a suborder for the Urothripoidea, for which I now suggest the name Pseudostigmata in place of Polystigmata. The latter name is, in the light of more recent knowledge, unfortunately inappropriate, and, as it has not been generally accepted, I think the more suitable name Pseudostigmata can now be introduced with advantage.

The many and peculiar morphological features found in members of the suborder Pseudostigmata are very fully described and commented upon in my original Memoirs (Bagnall, 1909 and 1911), and are subject only to a modified view as to the extra spiracles as already mentioned above. For the most part these features were overlooked by Buffa (1909), but fully confirmed (except as regards the above-named modification) by Trybom in his excellent descriptions (1912).

Hood and Williams in their Synopsis (1927) have not fully utilized these characters nor realized their importance. They also *suggest* that the palpi are 2-jointed, whilst in their key to the genera they state that the tube of both *Amphibolothrips* and *Bebelothrips*, Buffa has "four long hairs at

tip," whereas (while his drawings show 4 such hairs) Buffa distinctly describes three pairs (or 6) as being present, which is confirmed by *Amphibolothrips* material in my possession. Therefore the genus *Bradythrips*, H. & W., which is the only one remaining described as having four terminal hairs, should be closely examined for confirmation, as it seems to be an unnatural number to compose the circlet.

1. Species truly apterous; intermediate pair of coxæ the least widely separated. Antennæ stout, never more than 7-segmented and without the sense-bands, sense-areas, cones, or trichomes seen in the other suborders. Maxillary and labial palpi 1-jointed; eyes small, composed of a few largish irregular facets. Female without ovipositor. Tenth abdominal segment in both sexes tubiform, and ninth segment always longer than the eighth; terminal abdominal hairs very much longer than the tube. Chætotaxy limited and specialised. .... Suborder PSEUDOSTIGMATA, nom. nov. for POLYSTIGMATA, Bagn.

   Species generally winged; intermediate pair of coxæ the most widely separated. Antennæ 6-9 segmented with varying types of segmentation and sensoria according to the families; maxillary and labial palpi at least 2-segmented. Eyes generally well formed and multi-facetted; chætotaxy normal .... 2.

2. Female without ovipositor; tenth abdominal segment in both sexes tubiform, without exceptionally long hairs, and ninth segment not exceptionally elongated. Antennæ 8-segmented (exceptionally 7-segmented, the seventh joint caused by fusion of 7 and 8); all joints usually movable, and the intermediate joints more or less strongly elongated and furnished with simple sense-cones. Wings, when present, similar in structure; without costal or vein setæ and without microscopic surface hairs; fore wings with only *one* (usually shortened) median vein .... Suborder TUBULIFERA, Haliday.

   Female with a saw-like ovipositor formed from two pairs of gonapophyses arising from the eighth and ninth abdominal segments; tenth abdominal segment open ventrally, usually conical and rarely tubiform in the female, and usually bluntly rounded in the male; antennæ of varying form, 6–9 segmented. Wings covered with microscopic surface hairs; fore wings with marginal vein and one or two longitudinal veins reaching margin near apex of wing; [illegible] veins furnished with setæ ...... Suborder TEREBRANTIA, Haliday.

Coming to the major divisions within these suborders—that is, the superfamilies of Hood—we may take it that the Pseudostigmata and Tubulifera comprise but a single superfamily each, the Urothripoidea and Phlœothripoidea respectively. The Terebrantia, on the other hand, offer many complexes, some of which are difficult to understand, and new material has shown that the old main divisions of the Æolothripoidea and Thripoidea are not sufficient to show the true relationship of the contained groups, and this (in addition to re-establishing sub-ordinal rank for the Urothripoidea) is the main reason of this memoir.

In the accepted classification the upturned ovipositor, the broad wings rounded at ends, and the 9-segmented antennæ were sufficient to characterise the Æolothripidæ as opposed to the downturned ovipositor, the narrower pointed wings, and 6–8 segmented antennæ of the Thripidæ, but new exotic and fossil forms have made such a simple classification impossible.

The following key is an attempt to demonstrate the trend of my views on this important subject :—

1. Antennæ truly 9-segmented; fore tarsal claw usually present .... 2.
   Antennæ 6–8-segmented; fore tarsus simple; maxillary palpi 2- or 3-jointed and labial palpi 2-jointed; ovipositor downturned .. 6.
2. Ovipositor upturned, wings usually broad and rounded at ends; palpi varying in form and number of segments .... 3.
   Ovipositor downturned, wings usually narrow and pointed at ends; maxillary palpi 3-jointed and labial palpi 2-jointed ...... 5.
3. Antennæ with joints 3 and 4 elongated and truly cylindrical; maxillary palpi geniculate, 3-jointed (with 3 much shorter than 2) or 6–8-jointed; labial palpi 3–5-jointed (fore tibia or basal antennal joints never armed) .... Superfamily ÆOLOTHRIPOIDEA, s. str., with the families Æolothripidæ, Hal., Franklinothripidæ, Bagn., and Orothripidæ, Bagn.
   Antennæ and palpi otherwise; maxillary palpi not geniculate .... 4.
4. Antennæ with intermediate joints short, broad and flat, each furnished with at least 3 whorls of forwardly-directed bristles; joint 7 surmounted by a 2-jointed style. Maxillary palpi with a long basal joint and a series of 7 closely connate minor joints; labial palpi 4-jointed. Wings narrow near base, expanding broadly and roundly distally in the form of a battledore as in the Mymaridæ; the two longitudinal

veins of fore wing diverging considerably distally, and costal series of setæ continued along the lower margin, which is not truly ciliate .... Superfamily MYMAROTHRIPOIDEA, Bagnall, containing the family Mymarothripidæ, Bagn.

Antennæ normal, joints 3 and 4 not truly cylindrical, and all joints movable (*cf.* Heterothripoidea). Maxillary palpi 3-jointed (3 not markedly inferior to 2), labial palpi 2-jointed (*cf.* Heterothripoidea etc.). Wings broad, several times longer than broad, rounded at end, and fore wings with several cross-veins, lower margin ciliate (*cf.* Æolothripidæ and Orothripidæ); apex of fore tibia armed with a dagger-like scoop, or, if simple, antennal joint 1 or 2 so armed .... Superfamily MELANOTHRIPOIDEA, Bagnall, containing the family Melanothripidæ, Bagn. (recent and fossil).

5. Fore tarsal claw present; antennæ with all joints movable (*cf.* Melanothripoidea). Sensoria varying in type according to the family .... Superfamily HETEROTHRIPOIDEA, Bagnall, containing the families Heterothripidæ, Bagn., Opadothripidæ, Bagn. (chiefly fossil), and Stenurothripidæ, Bagn. (fossil).

Fore tarsal claw absent; antennæ with all joints movable (*cf.* Heterothripoidea), or joints 7–9 more or less connate and/or broadly styliform; sensoria ? ? .... Superfamily HEMITHRIPOIDEA nov., containing the family Hemithripidæ, Bagn. (chiefly fossil).

6. Antennæ 7–8-jointed, with 6 main joints (6 sometimes with a transverse suture) surmounted by a style of one or two joints; if only 6-jointed, the sixth derived by fusion with stylus (in *Aptinothrips* forms with and without styles occur). Joints 3 and 4 furnished with sense-cones, and not tympanum-like area or areas .... Superfamly THRIPOIDEA, s. str.

(*Note.*—Forms with 5 main antennal joints (the third being small and without sense-cone) and a style of one or two joints = Ceratothripidæ, Bagn. = Thripoidea ff. monstr.)

Antennæ 8-jointed, all joints movable, and joints 3 and 4 with tympanum-like area at end in place of sense-cone. Pronotum with longitudinal dorsal sutures; fore and hind femara markedly thickened, abdomen blunt, ovipositor very weak, apparently functionless .... Superfamily MEROTHRIPOIDEA nov., containing the family Merothripidæ, Hood (mostly recent).

The most interesting features in respect to this classification lie in the link afforded by the Hemithripoidea with the true 9-jointed antennæ of the Heterothripoidea, showing the transition to the styliform antennæ of the Thripoidea, whilst the separation of the Merothripoidea serves to stress its approach to the Tubulifera. Unfortunately, the bulk of the Hemithripidæ already known are fossil, so that the structure of the sensoria of the forms with true or freely movable 9-jointed antennæ are not clear; the recent species are Thripid in this respect, and it may be that a greater knowledge will show that this family is composed of forms that might more advisedly be taken into the Heterothripoidea and the Thripoidea respectively.

It should be added that Priesner has referred a fossil genus *Præmerothrips* with 9-segmented antennæ to the Merothripidæ, which would seem to bring the family into association with the Heterothripoidea.

1909. Bagnall, Richard S. "On *Urothrips paradoxus*, a new Type of Thysanopterous Insects." Ann. Mus. Nat. Hungarici, viii. pp. 125–136, pl. iii.

1911. Bagnall, Richard S. "Preliminary Notes on the Importance of the new Family Urothripidæ, Bagnall, in the Study of the Thysanoptera." Mem. 1er Congres International d'Entomologie, pp. 283–288, 1910.

1912. Bagnall, Richard S. "Some Considerations in regard to the Classification of the Order Thysanoptera." Ann. & Mag. Nat. Hist. ser. 8, vol. x. pp. 220–222 (Aug. 1, 1912).

1909. Buffa, Pietro. "Contribuzione alla conoscenza die Tisanotteri (due nuovi generi di Tubuliferi)." Boll. Lab. Zool. R. Scuola Superiore d'Agric. in Portici, iii. pp. 193–196, figs. (Jan. 22nd, 1909).

1927. Hood, J. Douglas, and Williams, C. B. "A Synopsis of the Thysanopterous Family Urothripidæ." Ann. Ent. Soc. America, xx. pp. 1–8, pls. i. & ii. (March 1927).

1912. Trybom, Filip. "Physapoden aus Natal und dem Zululande." Arkiv. für Zoologi, Bd. vii. No. 33, pp. 1–52 (Urothripidæ, pp. 31–47), pls. i.–v. (Nov. 6, 1912).

LX.—*On a new Species of Tick* (Ixodes victoriensis, *sp. n.*) *from Victoria, Australia.* By Stanley Hirst (Zoological Department, University of Adelaide, South Australia).

Ixodes victoriensis, sp. n.

♀.—*Body* usually widest between or just behind the posterior legs. *Scutum* longer than wide, being widest towards

the posterior end. *Cervical grooves* weak but sometimes distinct. *Lateral grooves* replaced by a well-marked sharply raised linear ridge. Surface of scutum smooth and polished, the punctations being very fine (microscopic). In pale examples there is a slender dark longitudinal marking in front of the genital opening. *Anal groove* oval in shape, being closed and pointed posteriorly, as in *I. holocyclus*, Nn. *Spiracle* a rather regular oval in shape. Dorsally the *base* of the *capitulum* has a little raised edge on each side. *Porose areas* oval and of moderate size, not being very widely separated from one another. Instead of being furnished with distinct tooth-like *auriculæ*, as is the case in *I. holocyclus*, the ventral surface of the capitulum has a long raised ridge on each side. *Legs* of normal length. *Coxæ* 1–3 with the outer spur well developed, especially that of the first. Fourth coxa with the spur scarcely visible. Anterior coxæ with a longitudinal ridge near the outer side. Inner spurs apparently absent. Fourth tarsus with the dorsal protuberance apparently weaker than in *I. holocyclus*, and this segment is not quite so abruptly narrowed as in that species.

♂.—*Body* long-oval in shape. *Dorsum* smooth and polished, only very fine microscopic punctations being present. *Cervical grooves* short and rather faint. There are also two oblique little grooves delimiting an area corresponding to the female scutum. *Lateral marginal groove* sometimes apparently doubled posteriorly (possibly an abnormality). *Anal grooves* convergent, uniting behind. *Base of capitulum* without any excavation dorsally. *Cornua* absent. *Legs* of moderate length. First *coxa* with a distinct outer spur; coxæ of second and third legs with shorter outer spurs; spur on fourth coxa very short. Inner spurs of coxæ not well developed. *Tarsus* of fourth leg sometimes more abruptly narrowed than in the female sex.

Measurements (in mm.).—♀. Length of body 6·75–13, its greatest width 4·6–8·5; length of scutum 2·35–2·5; greatest width of scutum 1·9–2·1 Length of body of male 2·9, its width 1·7.

Habitat.—Lower Tarwin, Victoria, 24. xi. 1925. Three female specimens, collected by G. F. Hill from a ring-tailed phalanger (*Pseudochirus peregrinus*), and three females and two males (both found *in coitu*) from a kangaroo (*Macropus nalabatus*) at the same locality. Types in collection of the National Museum, Melbourne.

BIBLIOGRAPHICAL NOTICE.

I Coleotteri d'Italia (catalogo sinonimico-topografico-bibliografico). By PAOLO LUIGIONI. *Memorie della Pont. Accademia delle Scienze—Nuovi Lincei.* Ser. ii. vol. xiii. pp. 1160. Roma, 1929.

BERTOLINI'S 'Catalogo dei Coleotteri d'Italia,' published nearly thirty years ago, contained many errors, and, besides, is now quite out of date. The present catalogue is intended to replace Bertolini, and to represent the state of our knowledge of the Coleoptera of Italy at the present time. It is a huge work, of 1160 quarto pages, but even so can only contain the names of the families, genera, species, and varieties, with synonyms and localities; there are no references to descriptions or to the original records of occurrence; nor, of course, is it possible within the limits of a single volume to comprise diagnoses of the 1699 genera, 9979 species, and 4402 varieties which make up the Italian coleopterous fauna. The term *variety* is used for forms which differ from the type of the species in secondary features, of size or of structure, which are always evident, and which characterize a number of individuals of a given region or locality; while *aberration* denotes those forms, occurring sometimes singly, which only differ from the species or variety by colour or by some very small divergence. In general the classification of Handlirsch is adopted, but for some families that of the recent catalogues of Junk, Winkler, and Reitter. The bibliography extends to eighty pages; separate indexes are given for the families, subfamilies, and tribes, and for the genera and subgenera; synonyms are not italicized. For the rest, it is impossible to review a work like this further than by giving some idea of its contents and of the magnitude of the undertaking, and indicating its enormous value to students of the Coleoptera, those of Italy in particular.

PROCEEDINGS OF LEARNED SOCIETIES.

GEOLOGICAL SOCIETY.

December 4th, 1929.—Prof. J. W. Gregory, LL.D., D.Sc., F.R.S., President, in the Chair.

The following communication was read:—

'The Avonian Succession in the South of the Isle of Man.' By Herbert Price Lewis, M.A., F.G.S.

The rocks described occupy a 'key' position in relation to Carboniferous rocks of the Irish Sea area. They lie within a basin, which is partly tectonic, between the Port St. Mary–Arbory Fault on the north-west, and the line of the Langness Ridge on the south-east.

The succession, which is of interest, in that it unites the lower part of the sequence established in the North-Western Carboniferous Province with the upper part of the succession recently worked out in the Middle Province, is as follows:—

	Lithological Divisions.	*Palæontological Divisions.*		*Approximate Thickness in Feet.*
	Scarlett Volcanic Series (mainly overthrust).	*Goniatites.* (Striatoid near the base.)		200 (Lamplugh)
Poyllvaaish Lime[illegible]one	Black Limestone.	*Goniatites falcatus* and Striatoids. *Cyathaxonia rushiana*, *Emmonsia parasitica*, *Goniatites punctatus*, and *Nomismoceras* sp.	P_{1b}	40
	Upper Knoll Limestone. (Coral-beds near the base.)	*Goniatites crenistria*, *Beyrichoceratoides truncatum*, and *Dibunophyllum* cf. *muirheadi*.	P_{1a}	340
	Lower Knoll Limestone.	*Beyrichoceras micronotum* and *Sagittoceras vesiculifer.*	B	100
	Upper Grey and Dark Limestone. (Strandhall and Scarlett.)	*Merocanites* cf. *applanatus*, *Caninia benburbensis* (maximum), *Chonetes* cf. *comoides*, and *Palæosmilia murchisoni.*	D_1	300
Lower Lim[illegible]	Lower Grey and Dark Limestone. (Derbyhaven, Langness, Ballasalla, and Port St. Mary.)	*Nematophyllum minus*, *Syringopora* spp., *Productus θ*,	S_2	150
		Punctospirifer ashfellensis, *Michelinia megastoma*, with *Chonetes carinata* and	S_1-C_2	90
		Syringothyris cuspidata var.	C_2	60
	Basement Conglomerate.			60
	(Unconformity.)			
	Manx Slate Series.			

The age of the Basement Conglomerate is probably near that of the Brownber Pebble-Bed, and much earlier than that of the Peel Sandstones and Conglomerate, which, if we may judge from their garnet-rich heavy mineral content, are of Upper Avonian or Upper Carboniferous age. The Lower Grey and Dark Limestones are of similar facies, and contain essentially the same fauna as the *Michelinia-grandis* and *Productus-corrugato-hemisphericus* Zones of the North-Western Province (from the *Camarophoria-isorhyncha* sub-zone upwards). As in the lower beds, a shallow-water facies dominates throughout the Upper Grey and Dark Limestones, of which the lower portion at Strandhall is faunistically the equivalent of beds of Lower *Dibunophyllum* age in the North-Western and Northern Provinces. The upper portion, at Strandhall, Scarlett, and Castletown, is almost identical in fauna and lithology with the uppermost Lower *Dibunophyllum* Beds (or D_1–D_2 passage-[illegible] the northern margin of the Midland Province.

Of the Poyllvaaish Limestones, the lower beds with Beyrichoceratids are referable to the 'Cracoean' division (B) of Bisat; while the Upper Knoll Limestone, containing *Goniatites crenistria* in abundance and *Dibunophyllum* cf. *muirheadi* with other D_2 Clisiophyllids near the base, is the Manx representative of the lowest division of the 'Bollandian' (P_{1a}).

Near the bottom of the dark *Posidonomys-becheri* Beds, which contain a goniatite-fauna typical of the Lower Bowland Shale (P_{1b}), is intercalated a *Cyathaxonia-Emmonsia* fauna of Upper D_2 phase, similar to that at the top of the Derbyshire Limestone. The junction between the *Posidonomya* Beds and the Scarlett volcanic tuffs is a disturbed one, but some limestones appear to have been interbedded with the lowest tuffs before movement occurred.

The Manx sequence is compared with that of other Carboniferous rocks surrounding the Irish Sea. Several corals, including some species new to science, are described, and faunal lists are given.

December 18th, 1929.—Prof. J. W. Gregory, LL.D., D.Sc., F.R.S., President, in the Chair.

Mr. D. J. SCOURFIELD exhibited specimens, photographs, and lantern-slides of an anomalous fossil organism from the Ludlow Beds of Logan Water, Lesmahagow (Lanarkshire). He said that the specimens had apparently been collected more than twenty years ago, but had been kept in the Kelvingrove Museum, Glasgow, by Prof. P. McNair, upon whose death they had passed into the charge of Prof. Gregory, who had very kindly allowed them to be exhibited that afternoon. The only reference to the specimens in geological literature appeared to be a few words at the beginning of a paper on *Cyamocephalus* by L. D. Currie.[1] Two points that struck one at once in looking at the specimens were that they evidently all belonged to the same type of organism, and that they were all fossilized in exactly the same position. The most constant feature, and one to be seen in all the sixteen specimens exhibited, was a somewhat ovoid body truncated at one end (assumed to be the top) and rounded at the other, which, for want of a better name, might be designated the 'capsule'. It ranged in size from 1 to 2½ inches, and was usually covered with a series of longitudinal lines or furrows which showed a tendency to radiate in the lower half of the capsule. Projecting from one side of the capsule were to be seen, in the more complete specimens, two segmented outgrowths or stems which, starting at some distance apart, the upper one from near the presumed top of the capsule and the lower one from about its middle, converged, and apparently met at a distance about equal to the length of the capsule. The upper one carried on its upper edge a series of eight or nine leaf-like processes, and the lower one on its lower edge a series of long spines. On the opposite side of the capsule there was a certain amount of structure, mostly indefinite, but including a very definite

[1] Geol. Mag. vol. lxiv (1927) p. 153.

narrow band of two or three lines (? tubes) which, approaching the capsule at nearly right angles, turned down abruptly, passed over the capsule obliquely, to be continued, in company with a number of other converging lines, towards a curved process situated well below the capsule. It had been thought by a number of persons who had seen the specimens or photographs that the organism must have been some peculiar type of Crustacean or at least an Arthropod, but he was unable to take that view. On the other hand, the organism did not appear to fit into any of the other classes of the animal kingdom, and it certainly did not seem to be a plant. He was very anxious to hear whether similar specimens had ever been found, and would welcome any suggestions as to the true nature of the organism.

Prof. W. T. Gordon exhibited a series of fossil plants collected at Wankie (Southern Rhodesia) during the visit of the International Geological Congress to that area. The flora of the Wankie coalfield will shortly be described by Mr. John Walton, who has added to the forms recorded from the coalfield in question by the late Dr. E. A. N. Arber. Mr. Walton agreed that copies of the plates for his paper should form an exhibit, together with these new specimens.

All the specimens shown came from the cuttings made by the Wankie Colliery Company, and were specially excavated by that company in anticipation of the visit of the Congress; but the earlier examples had been sent by Mr. Ben Lightfoot, and had formed the material on which Mr. Walton's determinations were based.

The specimens shown included the following:—

Glossopteris indica.	*Sphenophyllum thonii.*
Glossopteris browniana.	*Asterotheca* sp.
Phyllotheca sp.	*Pecopteris arborescens.*
Sphenophyllum oblongifolium.	*Cladophlebis* sp.

The special feature of this flora is the mixture of forms typical respectively of the Northern and of the Southern Flora of Palæozoic or early Mesozoic times. A considerable amount of discussion has ranged, recently, round the age of the *Glossopteris* Flora; and, as has been noted, the central genus *Glossopteris* is no good geological index. On the other hand, the evidence from marine beds, intercalated with strata containing members of the genus, is not in itself conclusive.

Search in the Wankie district, where the fossils are beautifully preserved as regards the leaf-form and venation, may help to clear up some of the points at issue; and what has already been accomplished indicates a mixture of forms characteristic of Upper Carboniferous and Lower Permian rocks of the Northern Hemisphere, with *Glossopteris* types.

Such evidence favours an age not younger than Lower Permian for the Wankie beds, and this seems to be confirmed by the evidence from Chinese coalfields, despite the opinion expressed by [illegible], who would place the *Glossopteris* Flora as not [illegible] Permian.

In conclusion, the exhibitor remarked that future researches in the Wankie district would be much welcomed by all interested in the problem.

January 8th, 1930.—Prof. J. W. Gregory, LL.D., D.Sc., F.R.S., President, in the Chair.

The following communications were read:—

1. 'Some Valentian Corals from Shropshire and Montgomeryshire; with a Note on a New Stromatoporoid.' By Stanley Smith, M.A., D.Sc., F.G.S.

The paper describes some Valentian corals recently collected in Shropshire and Montgomeryshire, which include a number of new forms. Hitherto, little systematic work has been done on the British pre-Salopian corals, although various species have been described from these rocks by Lonsdale, Phillips, and McCoy, and by later authors; many of these, however, were unfortunately founded on casts. The most important contribution made to our knowledge of the coral fauna of the Caradocian and Valentian of Britain was furnished by Nicholson & Etheridge in their 'Silurian Fossils of Girvan' (1878). The present work conclusively shows that the Valentian coral fauna is not primitive, and that it is more closely allied to Salopian than to Caradocian assemblages; nevertheless, the important place occupied by the species of *Streptelasma* in the *Pentamerus* Beds links these up with the Ordovician. The Purple Shales, on the other hand, have yielded several species of Rugose corals which are typically Salopian. The Tabulate corals are of little interest, except in so far that they prove the very long range of the Lower Palæozoic species; there seems to be little, if any, difference between the Caradocian, the Valentian, and the Salopian forms.

The paper concludes with a brief note on a Stromatoporoid which belongs to the genus *Clathrodictyon*, and is common in the *Calostylis* Limestone—a bed remarkable on account of its lithological character, no less than for its rich coral contents.

2. 'The Carboniferous Inliers at Codrington and Wick (Gloucestershire).' By Stanley Smith, M.A., D.Sc., F.G.S.

The Author describes several small inliers of Carboniferous rocks situated on the eastern side of the Bristol Coalfield, south of Chipping Sodbury, where, except for these outcrops, the margin of the basin is concealed by Mesozoic strata. The largest, and in every way the most interesting, of these is the Wick Rocks Inlier, which lies on the same line of latitude as the Avon Gorge—some 9 miles away to the west.

The several outcrops expose, although not quite completely, a succession of beds ranging from the Tournaisian (Z_2) to Coal Measures.

The arenaceous beds which succeed the limestone sequence are better exposed in the Wick Inlier than anywhere else in the

Bristol district. These belong in part to the Lower Carboniferous, in part to the Upper, and within the series (formerly mapped as 'Millstone Grit') a considerable break in the Carboniferous succession must occur, for, while the lower beds include some thin gritty limestones which contain Viséan fossils, the highest yield plant-remains characteristic of the Yorkian stage.

The arenaceous phase set in early in D_2 time, but calcareous conditions returned for a period before it finally established itself.

The paper, by concentrating upon the higher (arenaceous) sequence, and dealing in less detail with the lower (calcareous) development, supplements rather than amplifies the work of the late Arthur Vaughan.

The general succession of the Carboniferous in the area under discussion is as follows:—

Wick Rocks Inlier.

			Approximate thickness in feet.
Upper Carboniferous.			
	Beds with Yorkian plants	Grits, shales, and some thin impure coal-seams.	120
	Beds of uncertain age		350
Lower Carboniferous.			
Viséan.	D_3	Pebbly grits	30
		'Mollusca Band'	3
		Grits and shales	250
		'*Chonetes-polita* Limestone'	30
		Grits and shales	200
	D_2	'*Spirifer-wickensis* Limestone'	75
		Grits and shales	90
	D_1	Massive limestone, red-stained beds	225
	S	Do. do. grey limestones .... exposed	1000

Codrington: Eastern Inlier.

Tournaisian.	C_1	Massive limestone, '*Caninia* Oolite' .... seen	75
		Do. do. '*Laminosa* Dolomite'	25
	Z_2	Do. do. dark crinoidal limestone ... seen	50

The lowest part of the *Seminula* and the uppermost part of the *Caninia* Zones are nowhere exposed.

The Author tentatively places the gap between the Lower and the Upper Carboniferous at the top of the massive grits which contain the 'Mollusca Band.'

The sub-zone D_2 undoubtedly extends downwards to include the topmost beds of the massive limestone, but, for purposes of mapping, the whole of the red-stained beds are placed in D_1.

January 22nd, 1930.—Prof. J. W. Gregory, LL.D., D.Sc., F.R.S. President, in the Chair.

The following communication was read:—

'On the Geological Collection from the South Central Sahara made by Mr. Francis Rodd.' By Prof. John Walter Gregory, LL.D., D.Sc., F.R.S., Pres.G.S., Ethel Dobbie Currie, Ph.D., [illegible] J. Weir, M.A., Ph.D., S. Williams, M.Sc., Ph.D., [illegible] Tyrrell, Ph.D., F.R.S.E., F.G.S.

[illegible] the South Central Sahara was shown by the

work of Barth (1857) and Chudeau (1907, etc.) to consist of a foundation of gneiss, schist, and granite, on which rest in the north and west sheets of Devonian marine beds, and in the south Cretaceous limestones and subaërial sandstones. Mr. Rodd's collection adds much to our knowledge of the area.

The gneiss and schists have been called Silurian, but are probably pre-Palæozoic. Mr. Rodd's collection contains ancient gneisses and schists, and granites, with pegmatites and highly-kaolinized rocks. Mr. Rodd has found at In Nuguren, west of the Aïr Massif, well-preserved Turonian fossils, and among them Dr. Weir identifies *Exogyra olisiponensis*, which occurs in Angola, Tunis, Portugal, and Mexico, and, with the other fossils, affords evidence of a connexion of the sea in Angola with that of the Mediterranean across the Central Sahara. Some terrestrial deposits earlier than the Turonian limestones contain silicified fossil wood, which Dr. Williams has identified as *Dadoxylon* and as resembling the Upper Cretaceous *D. dantzii* of Tanganyika Territory. Dr. Williams's investigation of this material shows that *Dadoxylon* wood may be of stratigraphical value.

The igneous rocks collected are identified by Dr. Tyrrell as including basanite and phonolitoid ægirinetrachyte, and represent a northern extension of the Kainozoic volcanic series of Kenya and Kordofan.

It has been held that the Cretaceous limestones of the Sahara were part of a series that extended east and west in a depression parallel to the Mediterranean, and connected with the Gulf of Aden. Mr. Rodd's collection indicates that the Central Sahara was partly submerged by a Turonian transgression, which connected the Angola Gulf and the Lower Niger with Tunisia. It had a branch westward through In Nuguren towards the Middle Niger, but had no known connexion across Abyssinia with Somaliland or the Gulf of Aden.

February 5th, 1930.—Prof. J. W. Gregory, LL.D., D.Sc., F.R.S., President, in the Chair.

The following communication was read:—

'The Tuedian Beds of Northern Cumberland and Roxburghshire east of the Liddelwater.' By Prof. Edmund Johnston Garwood, M.A., Sc.D., F.R.S., V.P.G.S.

The series consists of sandstones, mudstones, shales, and impure limestones laid down mainly under lagoon conditions. An interesting feature is the important algal development in the middle of the series.

The beds are intermediate in character between the freshwater facies of the Tweed district and the more marine facies of Westmorland. The succession is described under three districts:—

Northern Cumberland (Bewcastle district).
Roxburghshire (Newcastleton district).
Western Northumberland (Rothbury).

In Northern Cumberland the structure is that of a denuded anticline having a general north-north-easterly trend. The district is also traversed by several important faults which preserve the same general direction.

This area may be divided into two districts separated by the 'central' fault.

The Bewcastle district in the east is taken as the type, and the following succession has been determined here :—

C–S		Kingwater Beds.
		Fell Sandstone.
C_2	Cam Beck Beds.	*Chonetes* aff. *hardrensis* Band.
		Syringothyris-Derbya Band.
		Upper *Productus-teres* Band.
C_1		Main Algal Series.
		Bewcastle Beds.
Z_2–C_1	Lynebank Beds.	Lower *Productus* Band.
		Myalina Beds.
		Pustula-interrupta Beds.

The base of the Carboniferous is not exposed, but the oldest beds containing *Pustula interrupta* and *Athyris concentrica* appear to belong to Z_2.

The algal episode enters first in the Bewcastle Beds; but the conditions were unfavourable, and it is not until the Main Algal Series is reached that algal growths become important as rock-builders. Nine main algal horizons occur in this series, varying in character from shaly mudstones, crowded with algal pellets, to massive 'reefs', the whole series having a thickness of 180 feet in Birkey Cleugh.

In the southern portion of the district, a later algal development occurs near the summit of the Cam Beck Beds, which is characterized by the association of *Spirorbis caperatus.*

On the whole, the fauna becomes more marine as the beds are traced from north to south, and near Spadeadam the highest beds of the Cementstone Series contain *Michelinia grandis* associated with an impoverished Arnside fauna testifying to their C_2 age. The beds at the summit of the Fell Sandstone in the Kingwater area contain a rich fauna, which may be compared with a similar assemblage that characterizes the S_1 beds on Ashfell Edge, overlying the Ashfell Sandstone. A further exposure of these beds occurs at Clattering Ford in the Black Lyne, but the overlying beds are difficult to correlate in the two districts.

In Roxburghshire east of the Liddelwater, the algal series is again well developed, but the Upper *Productus* Band is absent. An interesting occurrence, however, of the *Syringothyris* Band is found associated with *Palæacis* and a single specimen of *Vaughania.* In Northumberland, the chief feature of interest is the rich development of *Mitcheldeania* and *Ortonella* near the summit of the Cementstone Group, the latter genus being especially characteristic of the two highest limestones in the neighbourhood of Rothbury.

In the palæontological portion of the paper some new algal forms are described, and certain brachiopods are described in an Appendix by Miss H. M. Muir-Wood.

THE ANNALS

AND

MAGAZINE OF NATURAL HISTORY.

[TENTH SERIES.]

No. 30. JUNE 1930.

LXI.—*A Synoptic Classification of the False Scorpions or Chela-spinners, with a Report on a Cosmopolitan Collection of the same.*—Part II. *The Diplosphyronida (Arachnida-Chelonethida).* By JOSEPH CONRAD CHAMBERLIN, A.B., M.A., Stanford University, California, U.S.A.

[Concluded from p. 48.]

Superfamily *GARYPOIDEA*, nov.

Type. The family Garypidæ, Hansen.

Diagnosis and Remarks. Characterized in key to families. Essentially cosmopolitan in distribution, but primarily tropical and subtropical.

Family **Menthidæ**, nov.

Type. The genus *Menthus*, nov.

Diagnosis and Remarks. Previously characterized in key to the families. It includes a single genus from the subtropical deserts of Western North America.

Genus MENTHUS, nov.

Orthotype. *Minniza rossi*, J. C. Chamberlin.

Diagnosis. Abdomen vermiform. Carapace almost twice as long as broad, with almost parallel sides, extending posteriorly to a point even with the anterior margin of the third pair of coxæ, the body as a whole being more or less movably "hinged" or articulated at this point. Flagellum of four blades. Tergites and sternites entire.

Empodium pedicellate, the pedicel itself as long as the tarsal claws; subterminal seta simple. Fourth femoral articulation strongly oblique; femur of leg i. longer than, and movably articulated with, the patella.

Remarks. Originally confused with the genus *Minniza* by the writer. The similarities between these two desert genera is plain but superficial. The three included species may be separated by means of the following key:—

1. Fingers of chela clearly longer than the hand (about 1·3 times); chela at least 2·5 times as long as broad	2.
Fingers and hand of chela subequal in length; chela little more than twice (2·1) as long as broad (tibia clearly longer than femur)	*lindahli* (J. C. Chamberlin).
2. Femur and tibia subequal in length; chela 2·7 to 3·2 times as long as broad; femur 3·0–3·5 times as long as broad	*rossi* (J. C. Chamberlin).
Femur clearly shorter than tibia; chela about 2·5 times as long as broad; femur distinctly less (2·8 times) than thrice as long as broad	*californicus*, sp. n.

Menthus rossi (J. C. Chamberlin).
(Fig. 1 O; fig. 2 B; fig. 3 G.*)

1923 (*b*). *Minniza rossi*, J. C. Chamberlin, p. 365, figs.

Types. Holotype and allotype (JC. 128.01009–10) are deposited in the California Academy of Sciences.

Additional Material. Owing to an editorial omission, the only locality cited for this species in the original description was the type-locality itself. Material from the following localities was then at hand and studied at the same time. All known records are Mexican. Lot-numbers only are indicated:—

Sonora: San Pedro Bay (JC. 132.01).

Lower California: Las Animas Bay (JC. 346.01). Puerto Escondido (JC. 129.01). Cuesta Blanca (north of Loreto) (JC. 144.01). La Paz (JC. 135.01).

Islands of the Gulf of California: San Luis Island (JC. 134.01). Angel de la Guardia (opposite Pond Island) (JC. 146.01). Pond Island (JC. 142.01). Isla Partida (JC. 145.01). Isla Raza (JC. 133.01). Isla Sal si Puedes (JC. 137.01). South San Lorenzo Island (JC. 143.01). San Esteban Island (JC. 128.01). Tiburon Island; Willards Point (JC. 344.01); Indian Village (JC. 345.01). San Pedro Martir Island (JC. 131.01). South Santa Inez Island

* The figures referred to throughout this article appeared in the [illegible] for January 1930, pp. 2–4.

(JC. 343.01). Coronados Island (JC. 141.01). Carmen Island; Puerto Ballandra (JC. 126.01 and 130.01). Danzante Island (JC. 147.01). Monserrate Island; North end (JC. 342.01); South end (JC. 161.02). Santa Catalina Island (JC. 127.01). San Diego Island (JC. 338.01). San Francisco Island (JC. 337.01). Espiritu Santo Island; El Candeleros Bay (JC. 340.01); San Gabriel Bay (JC. 339.01). Ballenas Island (off coast of Espiritu Santo) (JC. 341.01). Ceralbo Island; Gordas Point (JC. 138.01); Rufo's Ranch House (JC. 139.01); El Mostrador (JC. 140.01).

Remarks. Considering the extensive and discontinuous (insular) range of this species it is remarkably constant, morphologically speaking. Indications are that careful study would permit the discrimination of several local varieties or subspecies.

Menthus californicus, sp. n.

Holotype, ♂ (JC. 535.01003); allotype, ♀ (JC. 535.01004); paratypes, 8 ♂ and ♀ (JC. 535.01001–2 and 5–10). Coll. by the author, under stones on desert hillsides, Palm Canyon (near Palm Springs), Riverside, California, iv.4.1925. 1 ♂, paratype (JC. 577.01001), coll. by the author under stone on desert hillside, viii.20.1924, Box Springs Grade, near Riverside, California.

Diagnosis. General appearance that of *rossi*. Movable finger of chela with 22–23 marginal teeth, which become progressively reduced posteriorly; fixed finger with 29–30 retro-conical teeth. Carapace as in *rossi*, twice as long as broad. Palps robust. Trochanter twice as long as broad and somewhat longer than hand; femur formed as in *rossi*, broadest basally and greatly narrowed distally, 2·8 times as long as broad, distinctly shorter than tibia and about the same length as the fingers; tibia of usual shape, 2·3 to 2·4 times as long as broad; chela 2·4 to 2·5 times as long as broad; fingers much (1·4 times) longer than the hand, which is at most only slightly longer than broad. Length 2·2 mm. A smaller species than either *rossi* or *lindahli*.

Menthus lindahli (J. C. Chamberlin).

1923 (*b*). *Minniza lindahli*, J. C. Chamberlin, p. 365, figs.

Remarks. Known only from the type-collection (JC. 125.01001–3), which was collected by the author under stones along a rocky beach at Tepoca Bay, Sonora, Mexico. The holotype is deposited in the collections of the California Academy of Sciences.

Family Olpiidæ, nov.

Type. The genus *Olpium*, L. Koch.

Diagnosis and Remarks. Characterized in key. Includes two well-marked subfamilies and a dozen genera, which are characterized in the following key. The family is nearly cosmopolitan, but reaches its greatest development in the arid tropics and subtropics of both Old and New World.

Analytical Key to the Subfamilies and Genera of the Olpiidæ.

1. Empodium plainly bifurcate (fig. 2 L); with at least a few of the anteriormost tergites and sternites completely divided into scutes by a longitudinal membranous band; flagellum of four blades, of which one may rarely be much reduced. (Subfamily GARYPININÆ, Daday.) .... 2.

   Empodium entire (figs. 2 Q, R); tergites and sternites entire throughout, never divided into scutes; flagellum clearly of three blades. (Subfamily OLPIINÆ, Banks.) .... 6.

2. Femoral articulation of leg i. submobile (fig. 1 AA); patella of leg i. distinctly shorter than femur (fig. 1 AA); IT slightly posterior to EST and much anterior to ESB; IB nearly even with ESB............................. 3.

   Femoral articulation of leg i. practically immobile and subvertical; patella of leg i. distinctly longer than femur; IT much posterior to EST, being about even with ESB; IB distinctly posterior to ESB .... 4.

3. T and ST distinctly more than 1–2 areolar diameters apart (about 3–5); ST scarcely if any farther from SB than T; ISB much closer to IB than to IST; lamina exterior small but clearly present; marginal teeth about as well developed on the movable as on the fixed finger of the chela......................... *Garypinus*, Daday, [p. 591.

   T and ST scarcely if any more than 1 areolar diameter apart; ST much closer to T than SB; ISB much closer to IST than to IB; lamina exterior completely absent; marginal teeth much more weakly developed on movable than fixed finger of the chela .... *Amblyolpium*, Simon, [p. 593.

4. T and ST absent; IB closely grouped with other members of the series—not isolated; lamina exterior absent; laminal seta much posterior to inferior seta

and about as far from the latter as from the laminal margin of the chelicera itself .... 5.

T and ST present; IB much posterior to the other three members of the series and solitary in position; lamina exterior small but distinct; laminal seta about even with posterior seta and approximately midway between it and the laminal margin of the chelicera .. *Serianus*, gen. nov., [p. 594.

5. Fingers of chela with prominent contiguous teeth (fig. 2 GG), which are about as well developed basally as distally; metatarsus iv. with a short tactile seta which is scarcely longer than the breadth of the tarsus itself; basal seta of chelicera absent; EST absent .... *Aldabrinus*, gen. nov., [p. 597.

Teeth of fingers of chela not prominent, scarcely contiguous, and much more strongly developed anteriorly than posteriorly; metatarsus iv. with a well-developed basal tactile seta which is longer than entire tarsus including the claws; basal seta of chelicera present; EST present .... *Solinus*, gen. nov., [p. 596.

6. Femoral articulation of leg i. of a vertical subimmobile type (fig. 1 DD); patella of leg i. nearly as long as, or plainly longer than, femur; ST rather closely associated with SB and B, so that the three form a loose cluster plainly distinct from T; tarsal claws often retractile or subretractile (fig. 1 T) .... 7.

Femoral articulation of leg i. garypoid in form (fig. 1 U) and freely mobile; patella of leg i. always distinctly shorter than femur; ST clearly distant from SB and B, not clustered therewith (about as in fig. 3 H); tarsal claws not usually retractile or subretractile (fig. 1 U)........................ 8.

7. With but a single tactile seta (ET) on distal half of fixed finger of chela; IT and EST almost transversely opposite each other and slightly to distinctly proximad of median; subapical lobe of chelicera well developed and sublobed or divided into two or more parts (*e.g.*, figs. 1 E, F) .... *Horus*, gen. nov., p. 598.

With at least two (ET and IT) tactile setæ on distal half of fixed finger and with EST at least submedian; IT much anterior to EST, so that they constitute longitudinal opposites; subapical lobe well developed and rounded, but not secondarily subdivided ...... *Xenolpium*, gen. nov., [p. 600.

8. Venom-ducts of long type ($\frac{1}{3}$ finger-length about, nearly as in fig. 3 C), the nodus ramosus lying clearly posterior to IT of fixed finger; apodeme of movable finger very large, subtriangular, and nearly closing the lumen of the finger (somewhat as in fig. 3 J) .... 11.

   Venom-ducts of short type, not extending to T in the mobile or to IT in the fixed finger ($\frac{1}{4}$ to $\frac{1}{5}$ finger-length, as in fig. 3 H); apodeme of movable finger never so prominently developed as to threaten the closure of the lumen .... 9.

9. Both IT and IST clearly anterior to EST, which is clearly proximad of median; tergites with 12–14 marginal setæ .... *Apolpium*, gen. nov., [p. 606.

   IT even with, or, at most, slightly anterior to, EST; IST much proximad of EST; EST about median; tergites with not more than 6 marginal setæ, usually with 2–4 .... 10.

10. Carapace extremely narrow, with subparallel sides, at least 1·5 times as long as broad, bearing two transverse internal folds, which appear superficially as "stripes" (fig. 2 C); EST and IT generally about transversely opposite each other .... *Minniza*, Simon, p. 604.

    Carapace with sides diverging behind, subgarypoid in form (fig. 2 D) and rarely more than 1·1 to 1·2 times as long as broad; without transverse stripes such as appear in *Minniza*, but sometimes with a weak posterior furrow; IT generally clearly anterior to EST .... *Olpium*, L. Koch, p. 602.

11. Tracheal trunks proximally inflated into large and conspicuous air-sacs; last (eleventh) tergite and sternite normally sclerotized; distal half of fixed finger bearing but two tactile setæ, ET and IT .... *Calocheirus*, gen. nov., [p. 607.

    Tracheal trunks normal, not inflated into air-sacs; eleventh tergite and sternite non-sclerotized, forming a membranous circum-anal ring; distal half of fixed finger bearing 4 tactile setæ, ET, EST, IT, and IST .... *Hesperolpium*, gen. nov., [p. 606.

Subfamily GARYPININÆ, Daday.

1887. *Garypininæ*, Daday, p. 179.
1906. *Garypininæ*, Daday, C. With, p. 91.

Type. The genus *Garypinus*, Daday.

Diagnosis and Remarks. Previously characterized. As here defined, it includes most of the species previously

assigned to the genus *Garypinus* plus certain of those assigned to *Olpium*. *Garypinus patagonicus*, Ellingsen, *Garypinus capensis*, Ellingsen, and *Garypinus mirabilis*, With, pertain, without doubt, to the present subfamily, but they cannot be generically placed in the system here proposed in the absence of material.

Genus Garypinus, Daday.

1887. *Garypinus*, Daday, p. 179.
1906. *Garypinus*, Daday, C. With, p. 111.

Genotype. *Olpium dimidiatum*, L. Koch.

Diagnosis and Remarks. The characterization given in the key is based primarily upon *marianæ*, sp. n. I have not seen the genotype. Four species may tentatively be referred to the genus. Their determination may be facilitated by means of the following key :—

1. Femur of palps clearly granulate at least along its anterior margin; carapace without a median transverse stripe	3.
Femur of palps completely smooth and non-granulate; carapace with a distinct median transverse stripe (*not* a furrow)	2.
2. First three tergites entire: from India	*birmanicus* With).
First tergite entire; tergites 2 and 3 divided: from Ecuador	*ortonedæ* (Ellingsen).
3. Femur-patella of leg iv. 2·6 to 2·8 times as long as deep; femur of leg i. 1·4 to 1·5 times as long as the patella: from the Western United States	*marianæ*, sp. n.
Femur-patella of leg. iv. 2·2 times as long as deep; femur of leg i. 2·5 times as long as the patella: from South-eastern Europe and Asia Minor	*dimidiatum* (L. Koch).

Garypinus marianæ, sp. n.
(Figs. 1 T, AA.)

Holotype, ♂ (JC. 391.02001); allotype, ♀ (JC. 391.02002); paratopotypes, 8 ♂, ♀, and ⊙ (JC. 391.02003–10): coll. by author from their delicate hibernation-capsules from under the bark-flakes on the trunk and main branches of the Madrone; Atherton, San Mateo County, California, xii.12.1927. Paratypes, ♂ (JC. 374.01001), coll. by Dr. F. R. Blaisdell, v.28.1925, in Yosemite Valley, California. 3 ♂ (JC. 10.02001–3), coll. by Mary C. Chamberlin and author, iii.26.1923, under bark of large Sequoia, Big Basin, Santa Cruz County, California. ♂, ♀, and ⊙ (JC. 563.01001–4), coll. by author and R. V. Chamberlin, vii.5.1927, under stones on steep hillside near Muir Woods, Marin County, California. ♂ (JC. 435.01001), coll.

xii.5.1927, at Tooele, Utah, in dry gulch north of smelter. 1 very immature individual (JC. 373.01001), coll. by "A. M. W." in Zion National Park in southern Utah, is almost certainly this species. Both of the Utah lots from Dr. R. V. Chamberlin.

Diagnosis. Fixed finger with 37–48 marginal teeth; movable finger with a similar number. Carapace typical, much longer than broad, and with 4 distinct eyes; chætotaxy about 6–4 (30 plus). Chelicera with 5 setæ on palm; galea slender and with three terminal recurved branches. Tergites i., ii., and xi. entire; bordered by 6–8 marginal setæ. Sternites with 9–12 marginal setæ. Palps robust. Trochanter smooth or nearly so, convex anteriorly and concave behind, 1·7–2·0 times as long as broad; femur weakly pedicellate, the pedicel merging rather gradually into the base of the femur proper, which, as a whole, is clearly clavate and broadest subterminally, distinctly and evenly granulate anteriorly, 2·9–3·2 times as long as broad; tibia smoothly convex behind, pedicel anteriorly differentiated, scarcely if at all granulate, 2·1–2·2 times as long as broad; chela swollen more acutely and distinctly behind than anteriorly (somewhat as in fig. 3 O), 3·0–3·3 times as long as broad; hand shorter than femur, but longer than tibia; fingers curved and much shorter than hand. Femur-patella of leg iv. 2·6–2·8 times as long as deep; femur of leg i. 1·4–1·5 times as long as patella. Length 3·0–3·8 mm.

Remarks. Named after Mary C. Chamberlin.

Garypinus dimidiatus (L. Koch).

1873. *Olpium dimidiatum*, L. Koch, p. 34.
1887. *Garypinus dimidiatus* (L. Koch), Daday, p. 179.
1910. *Garypinus dimidiatus* (L. Koch), Ellingsen, p. 388.

Remarks. Except for the proportions of the legs, this species seems almost identical with *marianæ*. According to Ellingsen's redescription the three anterior tergites are entire, and the face of the trochanter and tibia, as well as of the femur, is clearly granulate. The chætotaxy of the carapace and tergites and the chætotaxy and dentition of the chela await description.

Garypinus birmanicus (With).

1906. *Olpium birmanicum*, With, p. 109, figs.
1914. *Olpium birmanicum*, With, Ellingsen, p. 11.

Remarks. This species seems truly congeneric with the foregoing, but this cannot be established with certainty until the chætotaxy and dentition of the chela is known. It

is from India. Ellingsen (*t. c.*) is of the opinion that this and the following species, as well as "*Olpium biareolatum*, Tömösvàry," are synonymous, a decision that I am unable to accept without re-analysis.

Garypinus ortonedæ (Ellingsen).

1902. *Olpium ortonedæ*, Ellingsen, p. 159.
1907 (*b*). *Olpium ortonedæ*, Ellingsen, Tullgren, p. 67.
1914. *Olpium ortonedæ*, Ellingsen, Ellingsen, p. 11.

Remarks. From Ecuador. (See notes under preceding species.)

Genus Amblyolpium, Simon.

1898. *Amblyolpium*, E. Simon, p. 3.

Genotype. *Amblyolpium dollfusi*, E. Simon.

Diagnosis and Remarks. Characterized in key. Two species, which may be separated by means of the following couplet, may safely be referred to this genus. One is either French or possibly African, the other is Javanese:—

1. Fixed finger with 29 marginal teeth; femur of female 3·6 to 3·8 times as long as broad; chætotaxy of tergites i.–v. 6 : 6 : 6 : 8 : 8; fingers of chela about as long as tibia: French species, 3·4 mm. long .... *dollfusi*, E. Simon.
   Fixed finger of chela with 37–41 marginal teeth; femur of female 3·2, of male 3·8 times as long as broad; chætotaxy of tergites i.–v. 4:6:6:6:6; fingers of chela clearly longer than tibia: Javanese species, 2·0–2·2 mm. long . *bellum*, sp. n.

Amblyolpium dollfusi, E. Simon.

1898. *Amblyolpium dollfusi*, E. Simon, p. 3.

Material examined. 1 ♀, cotype (JC. 4.01001), exchange from Dr. L. Fage; labelled merely as from "France."

Remarks. I have been unable to see Simon's original description, and hence cannot verify "Collobrières" as the type-locality of this species. As cited in the 'Zoological Record' some doubt might legitimately be inferred, and an African locality seems to be a possibility. The species is no doubt closely related to the following Javanese form.

Amblyolpium bellum, sp. n.

Holotype, ♂ (JC. 259.01001), coll. by Dr. Th. Mortensen at "Banda," vi.1922; allotype, ♀ (JC. 253.01001), coll. by Dr. Th. Mortensen at Tjibodas, Java, viii.20.1922. Collections of Zoologiske Museum at Copenhagen.

Diagnosis. Movable finger of chela with 9 or 10 well-developed teeth anteriorly, which are preceded basally by about 15 low and inconspicuous ones; fixed finger with 41–42 clearly marked marginal teeth, which are better developed anteriorly than posteriorly. Carapace typical; with 4 distinct eyes; chætotaxy 4–4 (24). Tergites i. and xi. entire; ii. almost or quite divided, the rest completely divided into scutæ; chætotaxy 4 : 6 : 6 : 6 : 6 : 8 : 8. Sternites with 8 marginal setæ; sternites vi. and vii. with a median pair of large-areoled subtactile discal setæ. Metatarsus iv. with 1, tarsus iv. with 4 pairs of ventral setæ. Palps completely smooth and non-granulate. Trochanter concave behind and about 2·0 times as long as broad; femur broadest medianally, 3·1 times as long as broad; tibia stoutly pedicellate, slightly longer than hand and 2·3 times as long as broad; chela 3·2 to 3·3 times as long as broad; fingers slightly but clearly longer than hand. Femur-patella of leg iv. 2·0–2·3 times as long as deep; femur of leg i. 1·7–1·8 times as long as patella. Length 2·2 mm.

Genus Serianus, nov.

Orthotype. *Garypinus serianus*, J. C. Chamberlin.

Diagnosis and Remarks. Characterized in preceding key. Four American species (west coast of Mexico principally) are at present safely referable to this genus. In addition the Siamese species, *Garypinus nobilis*, With, seems to be congeneric. The four American forms may be separated by means of the following key:—

1. Fingers of chela about equal to or somewhat longer than the hand; femur and tibia of equal length; carapace and tergal scutæ strongly sclerotic; hand of chela ovate (somewhat as in fig. 3 W), not markedly angulate ecto-proximally; sternites vi. and vii. of male each with a single median pair of subtactile setæ ...... 2.
   Fingers of chela distinctly shorter than hand; tibia distinctly longer than femur; carapace and tergal scutæ very weakly sclerotic, almost membranous; hand elongate, with subparallel sides, strongly angulate ecto-proximally (fig. 3 O); sternites vi.–viii. of male with a median cluster of 3–5 setæ............... 3.
2. First 7 or 8 tergites completely divided; tergites 9 and 10 may show traces of partial division; femur 2·6–2·8 times as long as broad: large characteristically bark-dwelling species 3·0–3·5 mm. long .... *arboricolus* (J. C. Chamberlin).
   First 4 or 5 tergites only completely divided; tergites 5 or 6 to 8, or 9 partially divided, the

balance entire; femur 2·9 to 3·1 times as long as broad: small non-bark-dwelling species, 2·2 to 2·5 mm. long .... *litoralis* (J. C. Chamberlin).

3. Chela very stout and extraordinarily short-fingered, 2·6–2·7 times as long as broad; fingers of chela 1·1 to 1·3 times as long as breadth of chela .... *solus* (J. C. Chamberlin).

Chela more slender and longer fingered, 3·0 or more times as long as broad; fingers 1·4 or more times as long as breadth of chela ...... *serianus* (J. C. Chamberlin).

Serianus arboricolus (J. C. Chamberlin).

1923 (*b*). *Garypinus arboricolus*, J. C. Chamberlin, p. 369, figs.

Material examined. No new material has come to hand since the original description was written. Owing to an editorial omission in the original paper only the type-locality was cited. The collections examined at that time are therefore here listed (by lot-number only). All localities are Mexican.

Islands of the Gulf of California: San Esteban Island (paratopotypes) (JC. 172.01). San Pedro Nolasco Island (JC. 173.01). San Josef Island; Salt Works (JC. 365.01); lagoon at north end of island (JC. 174.01). Ceralbo Island (Rufo's Ranch House) (JC. 171.01).

State of Sonora: San Pedro Bay (JC. 364.01).

Lower California: 2 immature specimens (JC. 136.01 and 163.01) from La Paz are doubtfully referred to this species.

Serianus litoralis (J. C. Chamberlin).

1923 (*b*). *Garypinus litoralis*, J. C. Chamberlin, p. 368, figs.

Material examined. The species was described from a single male specimen (JC. 161.03001) from Monserrate Island, in the Gulf of California. Since then one additional male specimen (JC. 270.02001) has come to light. This specimen was collected by Prof. G. F. Ferris near Mazatlan, Mexico, near the sea-shore.

Serianus serianus (J. C. Chamberlin). (Fig. 2 L; fig. 3 O.)

1923 (*b*). *Garypinus serianus*, J. C. Chamberlin, p. 367, figs.

Material examined. Owing to an editorial omission only the type-locality of this species was given in the original paper. Material then at hand is therefore here briefly listed (lot-numbers only given). All material from Mexico.

Islands of the Gulf of California: Pelican Island (Kino Bay) (JC. 164.01). Isla Angel de la Guardia, opposite

Pond Island (JC. 165.01). Pond Island (JC. 362.01). Ceralbo Island (Gordas Point) (JC. 166.01).

New Material. ♂ (JC. 245.07001), coll. by Dr. Vasco Tanner, iii.19.1924, at St. George, Utah.

Remarks. The Utah specimen is slightly but distinctly slenderer than the average specimen from the Gulf region. This slender form may later prove to merit subspecific recognition. The species is close to *solus*.

Serianus solus (J. C. Chamberlin).

1923 (*b*). *Garypinus solus*, J. C. Chamberlin, p. 367.

Material examined. No material has come to hand since the original description. Again only the type-locality of this species was originally recorded. The following material (lot-numbers only) was, however, then at hand. All records are Mexican.

Las Animas Bay, Lower California (JC. 363.01). South Santa Inez Island (JC. 169.01). Ballenas Island (offshore from Espiritu Santo Island) (JC. 168.01). Angel de la Guardia Island (Palm Canyon) (JC. 167.01).

Genus Solinus, nov.

Orthotype. *Garypinus corticolus*, J. C. Chamberlin.

Diagnosis and Remarks. Characterized in key. Includes two species, one Mexican, the other Australian. It is closely related to *Aldabrinus*. The two included species may be separated by means of the following couplet:—

1. With 4 setæ on palm of chelicera; fingers and tibia of palpus subequal in length; fingers and hand of chela subequal in length; tibia twice as long as broad: from Mexico .. *corticolus* (J. C. Chamberlin).

   With 5 setæ on palm of chelicera; fingers clearly shorter than tibia of palpus; fingers plainly shorter than hand of chela; tibia 2·4 times as long as broad: from Australia .... *australiensis*, sp. n.

Solinus corticolus (J. C. Chamberlin).

1923 (*b*). *Garypinus corticolus*, J. C. Chamberlin, p. 366, figs.

Material examined. With one doubtful exception, no new material of this species has come to hand since its original description. However, for the reason that the only collection recorded in the original paper was the one containing the types themselves, the following summary of the original collections is here given. All localities are on the Mexican west coast.

Lower California: La Paz (JC. 175.01). Los Angeles Bay (JC. 176.01). Mulege (JC. 179.01). San Luis Gonzales

Bay (JC. 180.01). Concepcion Bay (Coyote Bay) (JC. 181.01); (Point Guadalupe) (JC. 366.01). Agua Verde Bay (JC. 182.01). Point Santa Antonita (JC. 367.01). Loreto (JC. 368.01). San Evaristo Bay (JC. 369.01).

Sonora: San Pedro Bay (JC. 177.01). Guaymas (JC. 178.01). South-eastern corner of Tiburon Island, Gulf of California (JC. 183.01).

New Material. Two very young specimens (JC. 562.02001–2), coll. by Prof. G. F. Ferris, under bark, Chivela, Oaxaca, Mexico, iv.13.1926, may possibly pertain to this species. The determination is highly uncertain, however, and is here listed merely for convenience.

Solinus australiensis, sp. n.

Holotype, ♀ (JC. 480.03001), coll. 1927 by Dr. S. Hirst at Barringun (frontier between Queensland and New South Wales), Australia.

Diagnosis. Movable finger of chela apically with 7 retrorsely acute teeth, preceded basally by 10 or 11 vestigial truncate ones; fixed finger apically with 10 retrorsely acute teeth, which are preceded basally by about 10 vestigial ones. Carapace typical; with 4 prominent eyes. Tergites and sternites with 4 border-setæ each; division of tergites obscure, but apparently as in *corticolus*. Palps smooth; general form closely similar to those of *corticolus*. Cheliceræ nearly as in *corticolus*, but with only 4 setæ on palm; tip of spinnerets broken in type. Trochanter apically swollen behind, almost as broad as femur; femur 3·2 times as long as broad, longer than tibia or hand, but shorter than carapace; tibia relatively slender, about as long as hand and 2·4 times as long as broad; chela longer than carapace, 3·4 times as long as broad, and plainly broader than deep; fingers distinctly shorter than hand. Length of possibly somewhat immature female 2·2 mm.

Genus ALDABRINUS, nov.

Orthotype. *Aldabrinus aldabrinus*, sp. n.

Diagnosis and Remarks. Characterized in key. The orthotype is at present the only known species. It is from the Aldabra Islands (north of Madagascar).

Aldabrinus aldabrinus, sp. n.

Holotype, ♀ (JC. 507.01001), labelled "Il Esprit, Aldabra Islands. December 1908." Collections of British Museum of Natural History.

Diagnosis. Chela extremely robust, the fingers beset from apex to base with contiguous, subequally developed (except for basal 5 or 6, which are lower and truncate), retro-conical (fig. 2 GG) teeth, which number 36 on either finger. Carapace much longer than broad, with a distinct transverse band (furrow?) clearly posterior of median; with two pairs of weakly developed eyes, the anterior pair of which is about an ocular diameter from the posterior pair and about two or more diameters from the rounded anterior carapacal margin; chætotaxy 4–4 (22). Tergites and sternites with 4–6 marginal setæ each. Palps robust, non-granulate. Trochanter evenly rounded anteriorly and posteriorly, 1·8 times as long as broad; femur shorter than carapace, thickly pedicellate, evenly rounded behind, anteriorly strongly convex, then weakly concave, 2·3 times as long as broad; tibia stoutly pedicellate, as long as femur, and twice as long as broad; chela much deeper than broad (as 7 to 10), 2·8 to 2·9 times as long as broad; fingers longer than hand and also longer than tibia. Length 3·2 mm.

Subfamily *Olpiinæ*, Banks.

1895. *Olpiinæ*, Banks, p. 10 (pars).

Type. The genus *Olpium*, L. Koch.

Diagnosis and Remarks. Both the subfamily and its included genera have been diagnosed in the preceding key. As originally defined this subfamily was grouped under the Obisiidæ, and included the genus *Atemnus*. This latter genus belongs, in reality, to a different suborder.

Genus Horus, nov.

Orthotype. *Garypinus obscurus*, var. *granulatus*, Ellingsen.

Diagnosis and Remarks. Previously defined in key. The species definitely assignable to this genus are from the southern hemisphere, Africa, and islands of the South Pacific. The four species here recognized may be separated by means of the following key:—

1. Tibia distinctly shorter than femur	2.
Tibia subequal to or longer than femur	3.
2. The trochanteral projections and the anterior faces of the tibia and femur plainly and evenly granulate; hand clearly shorter than tibia, "which is 2·4–2·5 times as long as broad"	*granulatus* (Ellingsen).
Palpal segments smooth and non-granulate; hand of chela as long as the tibia, "which is double as long as broad"	*obscurus* (Tullgren).

3. Tibia clearly shorter than hand; femur of leg i. clearly shorter than patella; tibia of palps clearly longer than femur; breadth and depth of chela the same	*oceanicus* (With).
Tibia slightly but clearly longer than hand; femur of leg i. equal to the patella in length; tibia of palps of same length as femur; depth of chela slightly but distinctly less than its breadth	*modestus*, sp. n.

Horus granulatus (Ellingsen). (Figs. 1 E, F.)

1912 (*a*). *Garypinus obscurus*, Tullgren, var. *granulatus*, Ellingsen, p. 116.

Material examined. 2 ♂, 1 ♀ (J.C. 40.01001–3), Kimberley, South Africa. Exchange from Dr. John Hewitt. This is apparently either paratype or topotype material I am personally of the opinion that *granulatus* is a good species, clearly different from *obscurus*.

Horus obscurus (Tullgren).

1907 (*b*). *Garypinus obscurus*, Tullgren, p. 68, figs.
1912 (*a*). *Garypinus obscurus*, Tullgren, Ellingsen, p. 115.

Remarks. I have not seen this species, but Tullgren's description is sufficient to indicate that the generic assignment here made is in all probability correct.

Horus modestus, sp. n. (Fig. 2 R.)

Holotype, ♂ (JC. 121.01001); allotype, ♀ (JC. 121.01002); paratopotypes, 2 ♀ and 1 ⊙ (JC. 121.01003–5); all from Alicedale, C.P., South Africa. Exchange from Dr. John Hewitt. The original material in the Grahamstown Museum, of which the above cited is a part, may properly be considered a part of the type-material. When this material was received it was labelled "*Olpium arabicum*, Simon." This is no doubt a misdetermination (see below).

Diagnosis. Marginal teeth of both fixed and movable fingers 28–30 in ♀ and 20–22 in ♂. Carapace smooth, secondarily membranous posterior to posterior border-setæ; anterior eyes less than their diameter from the anterior carapacal margin, which is smoothly rounded; appearance not at all garypoid; with 4 anterior and 2 posterior setæ. Tergites i.–iii. much narrowed, but normally sclerotized; tergites with 4 border-setæ each. Galea terminally trifid; not sexually differentiated; subapical lobe subdivided into two approximately equal parts. Palps unicolorous throughout; completely smooth and relatively slender. Trochanter convex anteriorly and excavated gently behind, 1·8–2·1 times as long as broad; femur pedicellate, almost bilaterally

swollen beyond pedicel, evenly convex behind, basally convex in front, distally weakly concave, broadest proximad of median, 2·5–2·6 times as long as broad; tibia smoothly convex behind, pedicellate and smoothly convex in front, 2·2–2·3 times as long as broad; chela pedicellate, nearly bilaterally expanded, sides of hand subparallel, 2·9–3·1 times as long as broad; fingers stout, strongly curved and much shorter than the hand, which is almost but not quite as long as tibia. Tibia subequal to femur. Length 2·1–2·7 mm.

Remarks. This species differs from *arabicum*, Simon (see Simon, 1890, p. 121), with which it was originally confused, in the unicolorous chela. Simon described *arabicum* as possessing a black hand and light fingers. This feature is characteristic of certain species of both *Olpium* and *Minniza*, but, so far as known, does not occur in the present group. As to whether the form recorded from South Africa under the name *arabicum* by Ellingsen (1912 (*a*), p. 116) pertains to this species or true *arabicum* I do not know.

Horus oceanicus (With).

1907. *Garypinus oceanicus*, With, p. 77, figs.

Remarks. I have not seen material of this species. I feel quite sure of the generic determination, but there remains the possibility that it should be referred to *Xenolpium* instead. With's material was from Funafuti.

Genus Xenolpium, nov.

Orthotype. *Olpium pacificum*, With.

Diagnosis and Remarks. Previously characterized. Two not very closely related species are here referred to this genus. They may be separated by means of the following couplet:—

1. Fingers clearly longer than hand; galea not sexually differentiated, three-branched (but not trifid) in either sex .... *pacificum* (With).
   Fingers clearly shorter than hand; galea of ♂ stylet-like, with vestigial or much reduced terminal branching; galea of ♀ with a stout practically obsolete shaft, which immediately divides into three elongate and gently diverging branches .... *amboinensis*, sp. n.

Xenolpium pacificum (With).

1907. *Olpium pacificum*, With, p. 75, figs.

Material examined. ♂ and ♀ (JC. 98.02001–2), from leaf-mould; rain-forest; Botanical Gardens, Wellington, New

Zealand. 3 ♀ (JC. 96.02001–3), from leaf-mould; from near Wellington, New Zealand. Both lots collected by Dr. E. R. Grimmett. ♀ (JC. 515.02001), from Ile Esprit, Aldabra, Dec. 1908 (north of Madagascar). This specimen was originally believed to represent a new species, to which I gave the manuscript name "*Garypinus latilaminus*." The specimen so labelled is now in the collections of the British Museum of Natural History.

Remarks. With described this species on the basis of a single, apparently somewhat immature, female, from Stewart Island, New Zealand. This specimen is now in the British Museum. The ♂ specimen (JC. 98.02001) may be designated as the allolectotype.

From a distributional standpoint the Aldabra Island specimen is of extreme interest. I am quite unable to find any characters which would justify its being considered specifically distinct.

It may be noted that fully mature specimens are somewhat more robust than the one figured by With. A somewhat immature female in my own collection (see above) matches With's description in every respect.

Xenolpium amboinensis, sp. n. (Fig. 2 T; fig. 3 T.)

Holotype, ♂ (JC. 256.06001); allotype, ♀ (JC. 256.06002); paratopotypes, 60 specimens, ♂, ♀, and ⊙ (JC. 256.06003–62). Coll. Feb. 1922 at Amboina (Dutch East Indies) by Dr. Th. Mortensen. Holotype, allotype, and paratypes in Zoologiske Museum at Copenhagen; paratypes in author's collection.

Diagnosis. Marginal teeth of both fixed and movable fingers well developed from apex to base; about 50 on either finger. Carapace anteriorly narrowed, somewhat emarginate antero-medially and subgarypoid in general appearance; with 4 prominent eyes, the anterior pair of which is about an ocular diameter from the anterior carapacal margin; chætotaxy 4–2 (24–28). Tergites i. to iii. narrowed, but normally sclerotic; tergites bordered by from 6–10 setæ. Galea sexually differentiated, small and stylet-like, with vestigial branching in male; large and three-cleft to base in female; subapical lobe simple and about subequal to the terminal tooth. Palps robust and distinctly granulate. Trochanter with a prominent conical granulate protuberance behind, evenly rounded anteriorly, 1·2 to 1·5 times as long as broad; femur pedicellate, swollen on both faces, but more conspicuously so behind, slightly narrowed terminally but

almost of the same breadth throughout, slightly but distinctly granulate along its anterior margin and 2·5 to 2·7 times as long as broad; tibia smoothly convex behind, with a stout pedicel differentiated anteriorly, beyond which it is evenly convex, inner face weakly granulate, 2·2–2·3 times as long as broad; chela pedicellate, with a nearly truncate base, convex on either side and granulate interiorly at base of fingers, 2·5 to 2·6 times as long as broad; fingers shorter than hand, which is in turn shorter than the femur or tibia. Length 2·8 to 3·7 mm. in male and female respectively.

Genus Olpium, L. Koch.

1873. *Olpium*, L. Koch, p. 33.
1879. *Olpium*, L. Koch, E. Simon, p. 49.

Genotype. *Obisium pallipes*, Lucas.

Remarks. The status of this genus cannot be firmly established until the real identity of the genotype is established. See notes under *Olpium pallipes* as given below. Whatever the fate of *Olpium* as such, the three species treated below are certainly congeneric.

Olpium tenuis, sp. n. (Figs. 1 J, U, V; figs. 3 H, I, W.)

Holotype, ♂ (JC. 526.01001); paratopotype, ♂ (JC. 526.01002). Coll. by Dr. S. Hirst, i.25.1923, at Wadi Halfa on the Sudan Frontier of Egypt. Paratypes, 2 ♂ (JC. 527.01001–2), coll. i.1923 by Dr. S. Hirst at Assuan, Egypt. Collections of British Museum except paratopotype (JC. 526.01002), which is in the author's collection.

Diagnosis. Marginal teeth 44–47 on fixed finger, well developed from apex to base; 38–44 on movable finger, becoming low and obsolete posteriorly. Carapace normal; with 4 prominent eyes; without transverse furrows or stripes; markedly depressed posteriorly. Tergites i. and ii. completely membranous; iii. narrowed but normally sclerotic; iv.–ix. normal. Tergal border-setæ 4, except on first tergite, where there are but 2. Chelicera normal; subapical lobe scarcely developed; galea distinct; shaft with 3 equal, gently recurved terminal branches. Palps extremely slender and graceful, the colour a light reddish brown with the exception of the hand, which is clearly blackish (fig. 3 W); inner margin of both femur and tibia with scattered but distinct granulations. Trochanter pedicellate, rounded behind and twice as long as broad; femur [illegible] expanding from base to tip, broadest distally, more

greatly swollen behind, 4·1–4·2 times as long as broad; tibia weakly pedicellate, distinctly shorter than femur, which latter is about as long as the carapace, 3·3 times as long as broad; chela slender, exteriorly rather abruptly convex, and then nearly straight, with basal half of the gently curved fingers interiorly evenly convex, 3·5 times as long as broad; fingers much (1·3 times) longer than hand, but distinctly shorter than tibia; hand distinctly broader than deep. Length 2·1 mm.

Remarks. May be separated from the form here assigned to *pallipes* by its slenderness. Unfortunately *pallipes* is known to me only from females, *tenuis* only from males, so that the real difference between the two is certainly not as great as might be inferred from the following couplet:—

1. Femur 4·3 times as long as broad; chela 3·6 times as long as broad; femur plainly longer than tibia; fingers equal to or shorter than femur.................... *tenuis*, sp. n.
   Femur 3·1 times as long as broad; chela 3·1 times as long as broad; femur and tibia subequal in length; fingers of chela clearly much shorter than femur.............. *pallipes* (Lucas) (?).

Olpium pallipes (Lucas), determination? (Fig. 1 D.)

1845. *Obisium pallipes*, Lucas, p. 277, figs.

Material examined. 2 ♀ JC.123.01001–2), labelled "*Olpium pallipes* (Lucas). Egypte." Exchange from Dr. L. Fage.

Determination. The determination of the above-recorded material is uncertain. The original determination was probably made by E. Simon, but the specimens do not agree with his own redescription of the species in question (Simon, 1879, p. 49). Neither do they agree with Ellingsen's redescription (Ellingsen, 1910, p. 392) nor Tullgren's (Tullgren, 1907, p. 10). I am at present in no position to unravel this tangle, and my material is merely tentatively left associated with this name.

My material differs from Simon's description in that the first two instead of the first three tergites are non-sclerotic. From Tullgren's redescription it differs in having the fingers and tibia both longer instead of shorter than the hand. From Ellingsen's description it differs in the palpal proportions, the female femur being 3·1 instead of 2·6 times as long as broad, and a tibia which is 2·5 to 2·6 times as long as broad instead of 2·1 times. Both Ellingsen and Tullgren describe their material as having the first "two or three" tergites membranous or unpigmented.

Olpium michaelsoni, Tullgren.

1909. *Olpium michaelsoni*, Tullgren, p. 412, figs.

Material examined. ♂ (JC. 481.01001), coll. vii.1928, Menindie, New South Wales. ♀ (JC. 478.01001), Tilpa, New South Wales, xi.4.1927. ♂ and 2 ♀ (JC. 480.05001–2 and 480.04001), at Barringun, on frontier between New South Wales and Queensland, 1927. All collected by Dr. S. Hirst.

Remarks. Tullgren described this species from a single female taken at "Stat. 77, Yalgoo," South-west Australia. My material seems to agree in every important respect with Tullgren's description and figures. It may be noted, however, that in the male the first tergite is membranous either in whole or part, while in the female all tergites are normally sclerotic. The femur and tibia are subequal in length; the femur is 3·0–3·3 times as long as broad; tibia 2·5–2·7 times as long as broad; chela 2·8–3·1 times as long as broad; the fingers are equal to or longer than the hand and equal to or shorter than the tibia. The marginal teeth of the chela number 40 on either finger.

Genus Minniza, Simon.

1881. *Minniza*, E. Simon, p. 90.
1906. *Minniza*, Simon, Ellingsen, p. 21. (Considers synonymous with *Olpium*.)

Genotype. *Minniza vermis*, E. Simon.

Diagnosis and Remarks. Characterized in key. All forms at present safely referable to this genus are desert species from Northern Africa. The species here recognized may be separated by means of the following key:—

1. Galea consisting of three equal terminal branches (fig. 1 D)	*solus*, sp. n.
Galea with a single submedian lateral and two terminal branches	2.
2. Femur slender, 3·2–3·6 times as long as broad; tibia 2·4–2·8 times as long as broad	*hirsti*, sp. n.
Femur stouter, 2·7–3·1 times as long as broad; tibia 2·1–2·3 times as long as broad	*vermis*, Simon.

Minniza vermis, Simon. (Figs. 2 Q, HH.)

1881. *Minniza vermis*, Simon, p. 90.
1906. *Olpium vermis* (Simon), Ellingsen, p. 21.

Material examined. 1 ♂ (JC. 124.01001), labelled "*Minniza vermis*, Simon. Egypte." Exchange from Dr. L. Fage. 2 ♂ and 2 apparently immature ♀ (JC. 524.02001–4), from

near Port Sudan, Egypt. Coll. ii.1923 by Dr. S. Hirst. ♂ and ♀ (JC. 524.02002–3), in collections of British Museum.

Remarks. I am accepting the determination of specimen 124.01001 given above as probably correct. It is presumably Simon's. Originally the Port Sudan material above recorded was determined by myself as an undescribed species, the manuscript name of which (*apora*) has never before been published. The specimens in the British Museum bear this manuscript designation. The species is a close relative of the more slender *hirsti*, sp. n.

Minniza hirsti, sp. n. (Fig. 2 C.)

Holotype, ♂ (JC. 528.01001); allotype, ♀ (JC. 528.01002); paratopotypes (JC. 528.01003–5), Luxor, Egypt. Coll. iii.9.1923 by Dr. S. Hirst. Paratopotype, ♂ (JC. 528.01005), in author's collection, balance in British Museum.

Diagnosis. Fixed finger with 25–30, movable finger with 23–25, marginal teeth, which are retro-conical (fig. 2 HH) anteriorly, becoming low and obsolete posteriorly. Carapace typical, not quite twice as long as greatest breadth. Tergites i.–iv. distinctly narrowed; four border-setæ per tergite. Chelicera normal, subapical tooth strongly triangular; galea with a somewhat recurved median and two equal terminal branches. Palps slender and graceful, largely unicolorous and deep reddish in colour, the tibia and chela somewhat more deeply pigmented than the trochanter or femur, but not with a distinct blackish or "smoky" cast. Trochanter 2·1–2·4 times as long as broad, with a small, rounded, weakly granulate process behind; femur smooth, pedicellate, and bilaterally swollen, broadest basally, and 3·2–3·6 times as long as broad; tibia smooth, stoutly pedicellate, strongly clavate, and 2·4–2·8 times as long as broad; chela stout, angulately swollen exteriorly and rounded interiorly, more greatly swollen on inner face, 3·0–3·2 times as long as broad; fingers distinctly longer than hand, somewhat curved, and shorter than femur or tibia, which are about subequal in length. Depth of chela distinctly greater than breadth; chela with fingers slightly gaping in both sexes. Length 3–4 mm.

Minniza solus, sp. n.

Holotype, ♀ (JC. 525.01001), Khartoum, Sudan (Egypt). Under stones in desert. Coll. ii.12.1923 by Dr. S. Hirst.

Diagnosis. Fixed finger with 23 low retro-conical teeth;

movable finger with 14 similar teeth, which become progressively lower and more inconspicuous posteriorly. Carapace typical, about 1·8 times as long as broad. First three tergites narrowed to less than half usual length; tergite iv. also narrowed; chætotaxy as in *hirsti*. Chelicera normal, subapical tooth as in *hirsti* and *vermis*; galea with three gently curved apical branches (about as in fig. 1 D). Palps slender, generally rather lightly pigmented, hand and tip of tibia blackish or "smoky" in colour. Trochanter 2·3 times as long as broad; femur weakly pedicellate, bilaterally swollen, gently curved and interiorly weakly excavated near tip, 3·5 times as long as broad; tibia as in *hirsti*, 2·7 times as long as broad; chela shaped as in *hirsti*, 3·7 times as long as broad; fingers gently curved, much longer than hand, but shorter than femur or tibia. Femur somewhat longer than tibia. Depth and breadth of chela about the same. Gaping of chela not observed. Length 2·8 mm.

Genus Apolpium, nov.

Orthotype. *Olpium cordimanum*, Balzan.

Diagnosis and Remarks. Characterized in key. The single included species is South American. It seems most nearly related to *Hesperolpium*.

Apolpium cordimanum (Balzan). (Fig. 2 D.)

1891. *Olpium cordimanum*, L. Balzan, p. 536, figs.
1906. *Olpium cordimanum*, Balzan, C. With, fig. 1, p. 17, tab. ii. figs. 6*a*, *b*.
1907. *Olpium cordimanum*, Balzan, C. With, p. 72.

Material examined. ♂ and ♀ (JC. 122.01001–2), New Granada, Colombia. Exchange from British Museum. These two specimens seem to be a portion of the material previously recorded by With. He also had the species from Bogota. Balzan's material was from Venezuela.

Genus Hesperolpium, nov.

Orthotype. *Olpium sleveni*, J. C. Chamberlin.

Diagnosis and Remarks. Characterized in key. Includes at present only the orthotype. The type-species is unique in possessing a series of 4–6 short, smoothly clavate, sensory setæ arranged in a contiguous file near the tip of the fixed finger of the chela. It is quite likely that this character is of true generic extent. The genus at present is known from the west coast of Mexico and southern California.

Hesperolpium sleveni (J. C. Chamberlin).

1923 (*b*). *Olpium sleveni*, J. C. Chamberlin, p. 63, figs.

Material examined. Owing to an editorial oversight, only the type-locality of this species was originally recorded. Material, however, was then at hand from the following Mexican localities :—

Lower California : Cuesta Blanca, Loreto (JC. 118.01). Palm Wells, Los Angeles Bay (JC. 119.01). San Luis Gonzales Bay (JC. 120.01). Puerto Escondido (JC. 335.01).

Islands of the Gulf of California : Santa Cruz Island (JC. 113.01). Coronados Island (JC. 114.01). Ballenas Bay, Danzante Island (JC. 115.01). Smith's Island, Los Angeles Bay (JC. 116.01). South Santa Inez Island (JC. 117.01). Puerto Ballandra, Carmen Island (JC. 334.01). North-westerm corner of Monserrate Island (JC. 336.01). Indian Village, Tiburon Island (field determination) (JC. 345.02).

New Material. ♂ and ♀ (JC. 375.01001–2), El Centro, Imperial County, California. Coll. by Dr. F. Blaisdell, xii.8.1927. Specimens small, but otherwise typical.

Genus Calocheirus, nov.

Orthotype. *Calocheirus atopos*, sp. n.

Diagnosis and Remarks. Characterized in key. Known only from the orthotype, which is Egyptian. Systematically the genus is rather isolated, but seems closest to *Hesperolpium*. As in *Apolpium*, there is a dorsal tactile seta on the base of the palpal femur.

Calocheirus atopos, sp. n. (Fig. 2 LL.)

Holotype, ♂ (JC. 524.01001), near Port Sudan (Egypt). Coll. ii.1923 by Dr. S. Hirst. Collections of British Museum.

Diagnosis. Fixed finger with 28 low, broad, and strongly retro-cuneate teeth, which become less developed posteriorly ; movable finger with a similar armature, but numbering only 11 or 12. Carapace of Olpiid type, and about 1·25 times as long as greatest breadth ; eyes 4 and well developed ; with a weakly developed posterior furrow ; cucullus narrowed and anteriorly emarginate. Tergites with 2 and sternites with 6 marginal setæ, all of which are minute and inconspicuons. Chelicera normal ; galea small and nearly stylet-like ; sub-apical lobe paired with terminal tooth. Palps of a very slender graceful type. Trochanter expanding to tip, 2·0 times as long as broad ; femur almost straight and scarcely pedicellate,

gently convex anteriorly, 4·1 times as long as broad; tibiæ pedicellate, distally with sides subparallel, 3·1 times as long as broad; chela greatly convex interiorly, exteriorly nearly straight and continuous with the scarcely curved finger, 3·4 times as long as broad; fingers much (almost twice) longer than hand, which is only a little longer than broad. Fingers longer than femur, which is clearly longer than tibia. Femur and carapace subequal in length. Chela broader than deep. Length 2·4 mm.

Family Garypidæ, Hansen.

1894. *Garypidæ*, Hansen, p. 231.
1906. *Garypidæ*, Hansen, C. With, p. 89.
1907. *Garypidæ*, Hansen, C. With, p. 66.

Type. The genus *Garypus*, L. Koch.

Diagnosis and Remarks. Characterized in key. Nearly world-wide in distribution, but primarily tropical and subtropical. It includes half-a-dozen genera and two subfamilies, which are characterized in the following key; of these *Synsphyronus* is of great theoretical interest:—

Analytical Key to the Subfamilies and Genera of the Garypidæ.

1. Stigmatic helix evident (fig. 2 U); fixed finger of chela, at least, with a number of basal accessory teeth (fig. 3 J); maxillary shoulder strongly developed (fig. 2 V); coxal area not diverging posteriorly as in true garypoid type; flagellum of a single blade; empodia always extending distinctly beyond tips of tarsal claws (fig. 2 I). (Subfamily Geogarypinæ, nov.) .. *Geogarypus*, gen. [nov., p. 609.

   Stigmatic helix obsolete (fig. 2 S); fingers of chela with marginal teeth in a single contiguous series, no accessory teeth; maxillary shoulder not developed (fig. 2 MM); coxal area distinctly diverging posteriorly (fig. 2 MM); flagellum with 3 or 4 blades; empodia either longer or shorter than tarsal claws. (Subfamily Garypinæ, Simon.) .... 2.

2. Empodia clearly shorter than tarsal claws (fig. 2 J); movable finger with 4 tactile setæ; vestitural setæ short, weakly developed, and acuminate or nearly so (fig. 3 P); femur of leg i. much longer (1·5 times or more) than patella; femoral articulation of leg i. freely mobile (fig. 1 S) .... *Garypus*, L. Koch, [p. 612.

   Empodia clearly longer than tarsal claws (figs. 2 I, K); movable finger of chela with 1 or 2 tactile setæ only; vestitural setæ more conspicuous than in *Garypus* and variously modified, but never completely simple (arcuately

acute, lanceolate or clavate (figs. 3 L, N, V)); femur of leg i. shorter or only slightly longer than patella; femoral articulation of leg i. only slightly mobile (fig. 1 CC) .... 3.

3. Metatarsus absent (figs. 1 BB, CC); flagellum of 3 blades; vestitural setæ strongly clavate (fig. 3 V); movable finger of chela with 2 tactile setæ .... *Synsphyronus*, [gen. nov., p. 616.

Metatarsus present (figs. 1 S, Z & Y, FF) ...... 4.

4. Vestitural setæ of palps lanceolate (figs. 3 M, N); flagellum of 4 blades; movable finger with 2 tactile setæ; femur clearly somewhat longer than patella in leg i. .... *Larca*, gen. nov., [p. 616.

Vestitural setæ clavate or arcuately acute (figs. 3 L, V); movable finger with but a single tactile seta; flagellum of 3 blades; femur of leg i. subequal to or somewhat shorter than patella .... 5.

5. Vestitural setæ of palps arcuately acute (fig. 3 L); fixed finger with a total of 7 tactile setæ (IB, presumably, absent) .... *Anagarypus*, [gen. nov., p. 615.

Vestitural setæ conspicuously clavate (fig. 3 V); fixed finger with 1 supernumerary seta, 9 in all .... *Maorigarypus*, [gen. nov., p. 617.

Subfamily GEOGARYPINÆ, nov.

Type. The genus *Geogarypus*, nov.

Diagnosis and Remarks. Characterized in key. Includes at present a single well-marked genus.

Genus GEOGARYPUS, nov.

Orthotype. *Garypus minor*, L. Koch.

Diagnosis and Remarks. Characterized in key. Apparently largely Asiatic and Australasian in distribution. This well-marked segregate of *Garypus*, as previously constituted, will include a large proportion of the species heretofore included in the mother-genus. Apart from those species treated herein, the following species probably belong in or near here:—*canariensis*, Tullgren; *impressus*, Tullgren; *javanus*, Tullgren; *longidigitatus* (Rainbow); *maculatus*, With; *personatus*, Simon; *senegalensis*, Balzan; *minutus*, Tullgren; and possibly *cuyabanus*, Balzan. The species known to me may be separated by means of the following key:—

1. Fixed finger with but 7 tactile setæ, ISB being absent; palps extremely slender, the chela more than 4 (4·2) times as long as broad .... *tenuis*, sp. n.

Fixed finger with the normal 8 tactile setæ, ISB clearly present; palps stouter than above, the chela less than 4 times as long as broad .... 2.

2. ESB and IB approximately transversely opposite each other, and as a pair are as far posterior of the isolated ISB as they are anterior of ESB (fig. 3 J) .... 3.
EST much anterior of IB and closely associated with ISB; IB and ESB nearly transversely opposite each other; tactile setæ of fixed finger not as in fig. 3 J .... 4.
3. Posterior pair of eyes situated entirely upon anterior half of carapace; palp not as in fig. 3 Q; galea of both male and female an unbranched stylet .... *irrugatus* (Simon).
Posterior pair of eyes clearly situated upon basal half of carapace; palps as shown in fig. 3 Q; female galea with 8 or 9 terminal branches (about as in fig. 1 N) .... *angulatus*, sp. n.
4. Carapace distinctly broader than long; anterior margin of femur and tibia thrown into a series of marked irregularities.... *minor* (L. Koch).
Carapace slightly longer than greatest breadth; anterior contour of femur and tibia regular, not thrown into rugose folds. *nigrimanus* (E. Simon).

Geogarypus minor (L. Koch).

1873. *Garypus minor*, L. Koch, p. 38.
1879. *Garypus minor*, L. Koch, E. Simon, p. 46.

Material examined. 5 ♀ (JC. 149.01001–5), Asani, Sardinia. Coll. A. H. Krausse. Exchange from Dr. A. Tullgren. ♂ and ♀ (JC. 150.01001–2), Algeria. Exchange Dr. L. Fage.

Remarks. The Algerian material above recorded differs in certain important respects from the Sardinian specimens, and it is not impossible that they are really different. In the absence of more extensive collections, however, I am in no position to settle the matter.

The species described under this name by Tullgren (1907 (*a*), p. 4, fig.), from the White Nile, I believe to be at least subspecifically distinct from the specimens which I have studied.

Geogarypus nigrimanus (Simon). (Figs. 1 M, N.)

1879. *Garypus nigrimanus*, E. Simon, p. 47.

Material examined. 2 ♂ and 1 ♀ (JC. 148.01001–3), "Southern France." Exchange Dr. L. Fage.

Remarks. This form is regarded as merely one phase of *minor* by Ellingsen (1908, p. 670), who, in defining this latter species, indicates a range of variation which would easily include the present form. For the present I prefer to let *nigrimanus* stand.

Geogarypus irrugatus (Simon).

1899. *Garypus irrugatus*, E. Simon, p. 122.
1906. *Garypus irrugatus*, E. Simon, C. With, p. 104, figs.

Material examined. 1 ♂ (JC. 254.01001), "Toeal, Kei Aferne" (Dutch East Indies?). Coll. 1922 by Dr. Th. Mortensen (Mortensen Collection). 4 ♂ and 3 ♀ (JC. 550.02001 and 503 D to I), Mt. Makiling, Luzon, Philippine Islands. Coll. Dr. C. F. Baker (2 ♂ and 1 ♀ from this lot deposited in collections of U.S. National Museum). 1 ♀ (JC. 501.01001), Amoy, China. Coll. v.14.1923 by Dr. S. F. Light.

Remarks. My determination of the above material is based upon With's very comprehensive redescription of the species.

Geogarypus angulatus, sp. n.
(Figs. 2 U, V; figs. 3 J, Q.)

Holotype, ♀ (JC. 539.01001), "Ootacamund, Nilgiris, at about 6700–8000 feet elevation." India. Coll. Dr. F. H. Gravely.

Diagnosis. Carapace evenly granulate; transverse furrows clearly developed; posterior eyes clearly posterior of median; carapace much broader behind than long, subequal in length to femur. Tergites apparently (?) undivided, bearing 11 or 12 weakly developed marginal setæ. Palpus as shown in fig. 3 Q; chela bearing on its inner margin a unique angular constriction at base of fingers; femur with 5 distinct seta-bearing tubercles. Tactile setæ and dentition of chela as shown in fig. 3 J. Chelicera normal; galea of female consisting of a stout shaft which bears 9 gently recurved terminal branches about as in fig. 1 N. Trochanter 1·5 times as long as broad; femur 3·1 times as long as broad; tibia 2·5 times as long as broad; chela 3·1 times as long as broad. Length 2·5 mm.

Geogarypus tenuis, sp. n.

Holotype, ♀ (JC. 565.01001), "No. 39; coll. E. E. Green." Presumably from Ceylon. Collections of British Museum.

Diagnosis. Carapace weakly but evenly granulate, somewhat broader behind than long; posterior eyes situated clearly on anterior half of carapace; cucullus normal and emarginate; both furrows present. Tergites very weakly granulate, bordered by about 12 weak setæ. Chelicera normal; galea lost in type. Palps very slender, especially chela; smoothly and evenly granulate except for fingers.

Trochanter about as in *angulatus*, 1·7 times as long as broad; femur scarcely pedicellate, weakly clavate, 4·2 times as long as broad; tibia with a stout bent pedicel, gently clavate, 2·8 times as broad as long; chela 4·2 times as broad as long; fingers much longer than hand or tibia, but shorter than femur. Femur plainly longer than tibia or carapace; carapace longer than tibia. Hand and tibia subequal in length. Base of hand peculiarly shaped, exteriorly smoothly and gently convex from pedicel to base of fingers; interiorly with pedicel very strongly differentiated, beyond which hand becomes convex, distinctly more so than exteriorly; fingers gently curved. Chætotaxy of chela as in *angulatus* (fig. 3 J), except that ISB is absent and SB is somewhat more basal in position; with about 30 marginal teeth in main series of fixed finger; movable finger with 31 marginal teeth, of which the posterior 16 or 17 are low, rounded, and inconspicuous. Length 1·5 mm.

Remarks. The holotype and only known specimen is in poor condition.

Geogarypus sp. indet. (Fig. 2 N.)

Material examined. 1 immature and mutilated specimen (JC. 459.01001), from Hiva Oa, Marquesas Islands. Coll. P. A. Johnson, xii.30.1924. Collections of British Museum. The immaturity and fragmentary character of the only specimen renders other than a generic determination impossible.

Subfamily *Garypinæ*, E. Simon.

1879. *Garypinæ*, E. Simon, p. 42.

Diagnosis and Remarks. Characterized, together with its included genera, in the preceding key.

Genus Garypus, L. Koch.

1873. *Garypus*, L. Koch, p. 38.
1879. *Garypus*, L. Koch, E. Simon, p. 45.

Genotype. *Garypus litoralis*, L. Koch (=*Garypus beauvoisii* (Savigny). Fixed by E. Simon.

Remarks. Includes a considerable number of species, all of which, so far as now known, are large littoral forms. It is probably to be found on the sea-shores of most tropical and subtropical countries of the world. In addition to the forms noted herein, the following species probably belong in or near *Garypus* as herein restricted:—*Garypus floridensis*, Banks, *Garypus hanseni*, With, and *Garypus saxicola* (Waterhouse).

Garypus beauvoisii (Savigny).

1827. *Obisium beauvoisii*, Savigny, t. 8. f. 6.
1873. *Garypus litoralis*, L. Koch, p. 40.
1879. *Garypus litoralis*, L. Koch, E. Simon, p. 48.
1910. *Garypus beauvoisii* (Savigny), Ellingsen, p. 387.

Material examined. ♂ and ♀ (JC. 155.01001–2), Southern France. Exchange from Dr. L. Fage.

Garypus maldivensis, Pocock. (Figs. 1 S, Z.)

1903–6. *Garypus maldivensis*, Pocock, p. 798, figs.

Material examined. I have seen Pocock's oiginal material, which consists of 3 ♀ (JC. 516.01001–3), Midu, Addu Atoll, Maldive Islands. One of these (JC. 516.01002) has been designated as the holotype. Collections of the British Museum.

Garypus pallidus, J. C. Chamberlin.

1923 (*b*). *Garypus pallidus*, J. C. Chamberlin, p. 362, figs.

Remarks. This species has not been taken since its original collection. The type-lot (JC. 154.01) was from Gordas Point, Ceralbo Island, Gulf of California, Mexico.

Garypus californicus, Banks. (Figs. 2 J, O, S, Z ; figs. 3 P, S.)

1909. *Garypus californicus*, Banks, p. 305.

Material examined. The following collections have not been previously recorded :—1 moulted skin (JC. 551.01001), from silken moulting capsule which was found under the bark of a wooden pile on the breakwater at Long Beach, California, coll. xii.13.1925 by author; 4 specimens (JC. 455.01001–4), Pismo Beach, California, coll. vii.18.1928 by Dr. E. C. Van Dyke ; 27 specimens (JC. 331.01001–27), Coronado, California, coll. i.19.1928 by Dr. Frank Blaisdell from under boards in salt-marsh ; 2 ♂ and 1 ♀ (JC.151.01001–3), Three Arches, Laguna Beach, California, coll. C. T. Dodds, viii.4.1921 on sandy beach under dried kelp.

Garypus giganteus, J. C. Chamberlin.

1921. *Garypus giganteus*, J. C. Chamberlin, p. 186, figs.
1923 (*b*). *Garypus giganteus*, J. C. Chamberlin, J. C. Chamberlin, p. 360.

Material examined. The following material has come to hand since this species was originally described :—10 ♂ and 2 ♀ (JC. 90.01001–12), Asuncion Island, Lower California,

coll. viii.1.1922 by Dr. G. D. Hanna and Mr. J. Slevin; 1 ♀ (JC. 91.01002), Jacks Bay, Guadalupe Island, Lower California, coll. by Mr. J. Slevin. The original collection, 1 ♀ (JC. 112.01001), was from Turtle Bay, Lower California.

Remarks. The additional material noted above fully supports my opinion as to the validity of this species.

Garypus sini, J. C. Chamberlin.

1923 (*b*). *Garypus sini*, J. C. Chamberlin, p. 361, figs.

Material examined. In the original paper only the type-locality was recorded. Material from the following west-coast Mexican localities was then at hand ; it has not been taken since :—

Lower California: Coyote Bay of Concepcion Bay (JC. 355.01); Agua Verde Bay (JC. 358.01).

Sonora: Tepoca Bay (JC. 159.01); San Pedro Bay (JC. 354.01).

Islands of the Gulf of California: San Luis Island (JC. 350.01) ; Granite Island, Puerto Refugio (JC. 157.01) ; Smith's Island (JC. 352.01) ; San Esteban Island (JC. 160.01); Tiburon Island, Indian Village (JC. 353.01) ; Willard's Point (JC. 344.02) ; Coronados Island (JC. 162.01) ; Carmen Island, Puerto Ballandra (JC. 158.01) ; Marquer Bay (JC. 156.01) ; Danzante Island (JC. 348.01) ; Monserrate Island, North End (JC. 356.01) ; South End (JC. 161.01) ; East Las Galeras Island (JC. 357.01) ; Santa Cruz Island (JC. 359.01) ; San Josef Island, Salt Works (JC. 360.01) ; Espiritu Santo Island, Isla Partida (JC. 347.01); El Candeleros Bay (JC. 349.01) ; San Gabriel Bay (JC. 361.01).

Remarks. A close relative of, but probably sufficiently distinct from, *Garypus giganteus.*

Garypus guadalupensis, sp. n.

Holotype, ♀ (JC. 91.01001), Jack's Bay, Guadalupe Island, Lower California, Mexico. Coll. vii.16.1922 by Dr. G. Dallas Hanna and Mr. Joseph Slevin. Collections of California Academy of Science.

Diagnosis. Carapace of typical form ; anteriorly emarginate ; clearly a little longer than posterior breadth ; anterior pair of eyes two ocular diameters from anterior carapacal margin. Chelicera typical ; serrula exterior with about 35 teeth ; galea with a strong shaft and about six recurved distal branches. Abdomen and tergites normally

developed ; each tergal scutum with a central dark spot as in *californicus*. First legs typical ; metatarsus with 5 and tarsus with 5 or 6 pairs of ventral setæ. Fourth legs in general typical; metatarsus with 7 and tarsus with 5 or 6 pairs of ventral setæ ; metatarsus fully twice as long as tarsus and very obliquely articulated thereto. Palps remarkably long and slender, the chela plus the tibia being plainly longer than the entire body. Palpal form typical of genus. Trochanter 1·7 times as long as broad, shorter than hand ; femur much longer than carapace but shorter than fingers, 5·2 times as long as broad ; tibia much shorter than femur but longer than carapace, 3·5 times as long as broad; chela ¾ as long as entire body and 4 times as long as broad ; fingers almost twice as long as hand and longer than tibia plus the trochanter ; movable finger distinctly shorter than fixed finger. Hand clearly broader than deep and 1·4 times as long as broad. Length 5·7 mm.

Remarks. Sharply distinct from all other American west-coast species of the genus. It seems more nearly related to *Garypus beauvoisii* than any other species known to me.

Genus ANAGARYPUS, nov.

Orthotype. *Anagarypus oceanus-indicus*, sp. n.

Diagnosis and Remarks. Characterized in key. Includes only the orthotype at present.

Anagarypus oceanus-indicus, sp. n. (Figs. 1 A, G, L, Q, R, Y, FF ; figs. 2 E, I, P, MM, NN ; figs. 3 K, L.)

Holotype, ♂ (JC. 519.01001) ; allotype, ♀ (JC. 519.01002) ; paratopotypes, 19 ♂ and ♀ (JC. 519.01003–21), Takamaka Island, Chagos Archipelago, xi.28th ; from cracks in red rocks. Paratypes, 8 ♂ and ♀ (JC. 508.02001–4 & 515.01001–4), Il Esprit, Aldabra Islands, xii.30.1908. Four paratopotypes and four paratypes in author's collection. Other material cited in collections of British Museum.

Diagnosis. Carapace of typical garypoid form, as shown in fig. 2 E ; with irregular but fairly constant patches of lighter and darker pigmentation. Tergites i., ii., and xi. undivided, the rest divided by a linear suture ; each scute with a median and lateral darker spot or area ; each tergite with 16–18 marginal setæ. Chelicera small and typical in structure (figs. 1 G, L) ; galea sexually differentiated (figs. 1 Q, R). Palps as shown in fig. 3 K, longer than body. Trochanter 1·3–1·4 times as long as broad ; femur 3·4–3·7 times as long as broad, clearly longer than carapace or tibia ; tibia 2·9–3·0

times as long as broad; chela 2·8–3·1 times as long as broad, clearly broader than deep; hand somewhat shorter than tibia, but much longer than fingers. Length 2·8–3·5 mm.

Remarks. Perhaps related to *Garypus insularis*, Tullgren, from which, however, it differs in numerous respects. This latter species is not a true *Garypus*, but whether or not it belongs in the present category cannot be ascertained in the absence of material.

Genus Larca, nov.

Orthotype. *Garypus latus*, Hansen.

Diagnosis and Remarks. Characterized in key. It includes two species, both of which have been previously described. They may be separated by means of the following couplet:—

1. Fingers distinctly a little longer than hand; chela of male four times as long as broad; tibia of male 3·2 times as long as broad; tibia as long as carapace: from New York .... *granulata* (Banks).
   Fingers very slightly shorter than hand; chela of female 4·4 times as long as broad; tibia of female 3·6 times as long as broad; tibia distinctly longer than carapace: from Denmark .... *lata* (Hansen)

Larca lata (Hansen). (Fig. 2 K.)

1885. *Garypus latus*, Hansen, p. 115, figs.

Material examined. Through the courtesy of Dr. Kai L. Henriksen I have been privileged to examine one of Hansen's co-types, ♀ (JC. 447.01001), from Jaegerspriis, Denmark. From the nest of a wasp (*Vespa*).

Larca granulata (Banks). (Figs. 3 M, N.)

1891. *Garypus granulatus*, Banks, p. 163.

Material examined. 2 ♂ (JC. 485.01001–2), Ithaca, New York. From Dr. R. V. Chamberlin.

Remarks. Closely related to *lata*, but distinctly more robust and differing in many details. Banks's original material came from the "crevices of a rocky cliff," Ithaca, New York.

Genus Synsphyronus, nov.

Orthotype. *Synsphyronus paradoxus*, sp. n.

Diagnosis and Remarks. Characterized in key. Known only from the orthotype, which is from Australia.

Synsphyronus paradoxus, sp. n. (Figs. 1 BB, CC; fig. 3 V.)

Holotype, ♂ (JC. 481.02001); allotype, ♀ (JC.481.02002); paratopotypes, 2 ♀ (JC. 481.02003–4). Menindie, New South Wales, Australia. Coll. vii.1928 by Dr. S. Hirst.

Diagnosis. Carapace of typical garypoid form; anteriorly emarginate; eyes situated plainly on anterior half of carapace, unusually small, the anterior pair between three and four ocular diameters from the anterior carapacal margin; posterior breadth of carapace plainly greater than length; transverse furrows absent or vestigial. Tergites i. and xi. entire, the balance divided by a linear suture; intersegmental membranes likewise linear; tergites, as in carapace, heavily sclerotic and nearly black in colour; bordered posteriorly by 12–14 clavate setæ. Cheliceræ small and typically garypoid; galea non-sexually differentiated, consisting of a stout unbranched stylet in either sex. Palps stout and rather coarsely but evenly granulate; clothed with moderately long and straight clavate setæ. Trochanter very strongly convex on either face, with a second protuberance behind, 1·1–1·2 times as long as broad; femur pedicellate, more strongly swollen posteriorly than anteriorly, anteriorly gently concave, then convex, posteriorly convex throughout, 3·4–3·5 times as long as broad; tibia with a stout, strongly bent pedicel 2·3–2·4 times as long as broad; chela as a whole conical, with a markedly truncate base, being broadest just beyond the sharply differentiated pedicel, bilaterally swollen, 3·3–3·5 times as long as broad; fingers as long as hand, slender and moderately curved; hand as long as tibia; femur as long as carapace. Length 2·6–3·0 mm.

Remarks. The single-segmented tarsus sharply differentiates this species from all others known to me. Withal it is not distantly related, generically speaking, to *Maorigarypus*.

Genus Maorigarypus, nov.

Orthotype. *Maorigarypus melanochelatus*, sp. n.

Diagnosis and Remarks. Characterized in key. Known only from the orthotype.

Maorigarypus melanochelatus, sp. n.

Holotype, ♂ (JC. 458.01001); allotype, ♀ (JC. 458.01002). Ohakune, New Zealand. Coll. iii.1923 by T. R. Harris. Collections of British Museum.

Diagnosis. Carapace of typical garypoid form, anteriorly emarginate; eyes situated clearly on anterior half of carapace,

the anterior pair about three ocular diameters from the anterior carapacal margin; carapace clearly broader than long; faint indications of both transverse furrows present. Tergites i. and xi. entire; ii.–x. divided by a linear suture; intersegmental membranes also linear; tergites and carapace rather lightly sclerotic and patterned much as in *Anagarypus oceanus-indicus*; each scutum with a median and lateral darker area. Tergites and carapace reticulated in a fashion suggesting *Feaella* and *Pseudogarypus* (this type of rugosity occurs also in *Synsphyronus* and other Garypids as well). Tergites bordered posteriorly by 6–8 clavate setæ. Chelicera small and typically garypoid; galea stout and with three terminal branches in female; broken in male. Palps stout, uniformly roughened by reticulations such as occur on the carapace and tergites, clothed with stout clavate setæ; chela more darkly pigmented than other palpal segments, blackish in colour. Trochanter strongly convex anteriorly and posteriorly, with two small protuberances behind, 1·3–1·4 times as long as broad; femur pedicellate, equally but somewhat irregularly expanded toward tip, 4·0–4·3 times as long as broad; tibia with a stout strongly bent pedicel, 2·6–2·8 times as long as broad; chela pedicellate, bilaterally swollen (but somewhat more abruptly exteriorly), broadest subbasally, but not sharply and progressively narrowed thereafter as in *Synsphyronus paradoxus*, 3·4 times as long as broad; fingers plainly longer than hand and moderately curved. Hand distinctly broader than deep and somewhat shorter than tibia; femur longer than carapace. Length 3·4–4·0 mm.

3. Bibliography.

Only papers cited in the text are here listed. Serials are abbreviated as far as possible, in accordance with the system employed by the 'Zoological Record.'

Balzan, Luigi. 1890. "Revisione dei Pseudoscorpioni del Bacino dei Fiumi Paraná e Paraguay nell' America Meridionale." Ann. Museo Civ. st. nat. Genova, (2) xxix. pp. 401–451.

——. 1891. "Voyage de M. E. Simon au Venezuela. Chernetes (Pseudoscorpiones)." Ann. Soc. Ent. Paris, (1) lx. pp. 497–552.

Banks, Nathan. 1891. "Notes on North American Chernetidæ." Canad. Entomol. Orillia, Ont. xxiii. pp. 161–166.

——. 1893. "New Chernetidæ from the United States." Canad. Entomol. Orillia, Ont. xxv. pp. 64–67.

——. 1895. "Notes on the Pseudoscorpionida." J. New York Ent. Soc. iii. pp. 1–13.

——. 1898. "Arachnida from Baja, California, and other Parts of Mexico." Proc. Calif. Acad. Sci. San Francisco, ser. 3, i. (7) p. 269.

Banks, Nathan. 1909. "New Pseudoscorpionida." Canad. Entomol. Orillia, Ont. lxi. pp. 303–307.

Chamberlin, Joseph Conrad. 1921. "Notes on the Genus *Garypus* in North America." Canad. Entomol. Orillia, Ont. liii. pp. 186–191.

——. 1923 (*a*). "The Genus *Pseudogarypus*, Ellingsen." Ent. News, Philadelphia, xxxiv. pp. 146–149, 161–166.

——. 1923 (*b*). "New and little-known Pseudoscorpions principally from the Islands and adjacent Shores of the Gulf of California." Proc. Calif. Acad. Sci. San Francisco, ser. iv. xii. (17) pp. 353–387.

——. 1925. "On a Collection of Pseudoscorpions from the Stomach-contents of Toads." Univ. Cal. Pub. Tech. Bul. Coll. Agric. Exp. Sta. Ent. iii. (4) pp. 327–332.

——. 1929. "A Synoptic Classification of the False Scorpions or Chela-spinners, with a Report on a Cosmopolitan Collection of the same.—Part I. The Heterosphyronida." Ann. & Mag. Nat. Hist. London, ser. 10, iv. pp. 50–80.

Dady, Eugene von. 1887. "Uebersicht der Chernetiden des Hungarischen National Museums in Budapest." Térm. füzetek. Budapest, xi. pp. 111–136, 165–192.

Ellingsen, Edvard. 1902. "Sur la Faune de Pseudoscorpions de l'Equateur." Mem. Soc. Zool. Paris, xv. pp. 146–168.

——. 1906. "Report on the Pseudoscorpions of the Guinea Coast (Africa) collected by Leonardo Fea." Ann. Museo Civ. st. nat. Genova, ser. 3, ii. pp. 243–265.

——. 1907. "On some Pseudoscorpions from Japan collected by Hans Sauter." Nyt. Mag. Naturv. Kristiania, xlv. (1) pp. 1–17.

——. 1908. "Notes on Pseudoscorpions." Ann. Museo Civ. st. nat. Genova, ser. 3, iii. pp. 668–670.

——. 1909. "On some North American Pseudoscorpions." Boll. Lab. Zool. Portici, iii. pp. 216–221.

——. 1910. "Die Pseudoskorpione des Berliner Museums." Mitt. Zool. Mus. Berlin, iv. (3) pp. 357–423.

——. 1912 (*a*). "The Pseudoscorpions of South Africa, based on the Collections of the South African Museum, Capetown." Ann. S. Afric. Mus. Capetown, x. pp. 75–128.

——. 1912 (*b*). "II. Sauter's Formosa-Ausbeute. Pseudoscorpions from Formosa I. Meddels. Fra Norsk Ent. Foren. 1. (6) pp. 121–128.

——. 1914. "On the Pseudoscorpions of the Indian Museum." Records Ind. Mus. Calcutta, x. (1) pp. 1–14.

Hagen, Hermann. 1869. "The American Pseudo-Scorpions." Rec. Am. Ent., Salem. (for 1868), p. 48.

Hansen, H. J. 1885. "Spindeldyr." Zoologica Danica, Kjϕbenhavn, pp. 81–131.

——. 1894. "Organs and Characters in different Orders of the Arachnids." Ent. Medd. Kjϕbenhavn, iv. pp. 137–251.

Illiger, J. K. W. 1798. In Kugelann, 'Verzeichniss der Käfer Preussens.' Halle.

Kästner, A. 1928. "Pseudoscorpiones." In 'Die Tierwelt Mitteleuropas' (Quelle & Meyer, Leipzig), iv. pp. 1–13.

Kew, H. Wallis. 1911. "A Synopsis of the False Scorpions of Britain and Ireland." Proc. R. Acad. Dublin, xxix. pp. 38–64.

Koch, Ludwig. 1873. 'Uebersichtliche Darstellung der europäischen Chernetiden (Pseudoscorpione).' Nürnberg (Bauer & Raspe, E. Küster), pp. 68.

LEACH, W. L. 1817. "On the Characters of the Scorpionidea, with Descriptions of the British Species of *Chelifer* and *Obisium*." Zool. Misc. iii. pp. 48–53.

LUCAS, H. 1845. "Les Arachnides, les Myriopodes et les Hexapodes de l'Algérie." In 'l'Exploration Scientifique de l'Algérie,' p. 243.

POCOCK, R. I. 1904. "Arachnida." In 'Fauna and Geography of the Maldive and Laccadive Archipelagoes,' ii. (3) pp. 797–805.

REDIKORZEV, V. 1917. "Pseudoscorpions nouveaux.—I." Ann. Mus. Zool. Petrograd, xxii. pp. 91–101. (Published 1922.)

——. 1922. "Two new Species of Pseudoscorpions from Sumatra." Ann. Mus. Zool. Petrograd, xxiii. pp. 545–554.

SAVIGNY, J. C. 1827. 'Description de l'Égypte. Histoire naturelle, Zoologie. Iconographie des Crustacés et des Arachnides de l'Égypte.' (Texte par Audouin; planches par Savigny.) Paris, ed. ii.

SCHIØDTE, J. C. 1848. "Bidrag til den underjordiske Fauna." Vid. Selsk. Skr. Kjøbenhavn, ii. pp. 1–39.

SIMON, EUGÈNE. 1872. "Notice sur les Arachnides cavernicoles et hypogés. Ann. Soc. Ent. Paris, ser. 5, ii. p. 224.

——. 1878. "Description de quelques Cheliferidæ de California." Ann. Soc. Ent. Paris, ser. 5, viii. pp. 154–158.

——. 1879. 'Les Arachnides de France.' 7 vols. Paris. "Chernetes," vii. pp. 1–78.

——. 1881. "Descriptions d'Arachnides nouveaux d'Afrique. Chernetes de la Basse Égypte rec. par M. Letourneux." Bull. Soc. Zool. Paris, vi. pp. 1–14.

——. 1890. "Études sur les Arachnides de l'Yemen." Ann. Soc. Ent. Paris, ser. 6, x. pp. 120–122.

——. 1898. "Étude sur les Arachnides de la région des Maures." Feuille, des jeunes Natural., Paris, xxix. pp. 2–4.

——. 1899. "Cont. à la faune de Sumatra. Arachnides recuellis par M. L. Weyers à Sumatra." Ann. Soc. Ent. Belgique, xliii. pp. 120-123.

TULLGREN, ALBERT. 1907 (*a*). "Solifugæ, Scorpiones und Chelonethi aus Aegypten und dem Sudan." Results of the Swedish Expedition to Egypt and the White Nile, 1901, no. 21A, pp. 1–12 (Uppsala, 1907).

——. 1907 (*b*). "Zur Kenntniss aussereuropäischer Chelonethiden des Naturhistorischen Museums in Hamburg." Jahrb. wiss. Anst. Hamburg, xxiv. pp. 21–75.

——. 1909. "Chelonethi." Die Fauna Südwest Australiens, hrsd. V. W. Michaelson u. R. Hartmeyer, ii. (23). Jena, pp. 411–415.

WITH, CARL. 1905. "On Chelonethi, chiefly from the Australian Region, in the Collections of the British Museum, with Observations on the 'Coxal Sac' and on some Cases of Abnormal Segmentation." Ann. & Mag. Nat. Hist. London, ser. 7, xv. pp. 94–143.

——. 1906. "Chelonethi." Vid. Selsk. Skr. Kjøbenhavn, iii. pp. 1–214.

——. 1907. "On some new Species of Cheliferidæ, Hans., and Garypidæ, Hans., in the British Museum. Journ. Linn. Soc., Zool., London, xxx. pp. 49–86.

LXII.—*A Comparative Study of the Otoliths of the Neopterygian Fishes* (concluded). By G. Allan Frost.

[Plate XXIII.]

XXI. Order DISCOCEPHALI.

The otolith of *Echeneis naucrates* (Pl. XXIII. fig. 1)—family Echeneididæ—is of the Percid type and resembles that of *Chromis chromis* * of the family Pomacentridæ. It differs in the narrow front, in the more posteriorly placed projection of the dorsal rim, and in the sulcus, which resembles that of *Anableps tetropthalmus* † of the order Synentognathi.

XXII. Order PLECTOGNATHI.

The otoliths of the order Plectognathi are curiously aberrant in form, showing little affinity with those of the other orders.

1. Division Sclerodermi.

In *Triacanthus brevirostris* (Pl. XXIII. fig. 2)—family Triacanthidæ—the sagitta is highly specialized; the dorsal rim is highest posteriorly, where it consists of a comb-like formation of three dentations; anteriorly it is rounded, passing into the anterior rim; the posterior rim is straight, with a small pointed projection at its junction with the curved ventral rim; the anterior rim is roughly rounded in its upper part, and contains a double-pointed rostrum and deep excisura. The upper part of the inner side of the otolith has a flat narrow margin running parallel with the dorsal rim, and below this the surface slopes away and is deeply excavated where it meets the lower part of the otolith; there is no upper margin of the sulcus, but the lower margin is sharply raised and has a strong median angle; below this a well-defined groove is present.

In the example examined the sagitta of *Balistes capriscus* (Pl. XXIII. fig. 3)—family Balistidæ—resembles *Triacanthus* in the hollowed-out upper part of the otolith, in the raised margin of the lower part, which, however, is continued on the lower posterior rim, and in the bulging upper part of the anterior rim. It differs in the large narrow rostrum,

* Frost, Ann. & Mag. Nat. Hist. ser. 10, vol. i. pl. xvii. fig. 3 (1928).
† *Op. cit.* ser. 9, vol. xviii. pl. xxi. fig. 31 (1926).

in the double angle of the lower margin of the sulcus, in the slightly curved ventral rim, and in a large wing-like posterior projection, which is unique and may be abnormal.

The sagitta of *Ostracion gibbosus* (Pl. XXIII. fig. 4)—family Ostraciontidæ—is also highly specialized, the shape being high and unusual; the anterior part of the dorsal rim is curved, sloping to the point of the antirostrum, and its posterior part resembling that of *Triacanthus*, three dentations forming a comb-like projection, but with a backward inclination. The upper part of the posterior rim is concave and the lower part rounded; the ventral rim is deep and has a slight median angle; and the anterior rim contains a pointed rostrum, an antirostrum, and an excisura. The sulcus opens on the anterior rim and is undivided; the caudal end is upturned and pointed, and does not reach the posterior rim.

2. Division Gymnodontes.

The sagitta of *Tetrodon fahaka* (Pl. XXIII. fig. 5)—family Tetrodontidæ—resembles in some features that of *Triacanthus*. The upper part of the otolith has a flat margin on the dorsal rim, and is depressed at its junction with the lower part; it differs in the posterior rim, which is inwardly inclined, leaving an indentation between it and the projecting lower part of the otolith; it also differs in the absence of projections on the dorsal rim. The ventral rim is rounded and serrated, passing into the rounded part of the posterior rim; the anterior rim is oblique and inwardly inclined in its upper part, and below consists of a blunt upturned rostrum, a large angular excisura being present. A crescentic ridge runs from the rostrum upwards to the rear of the depressed upper part of the otolith, and a tooth-like process rises behind the rostrum, forming the posterior margin of the excisura.

Common features in the sagittæ of *Triacanthus*, *Balistes*, and *Tetrodon* are the hollowed upper part of the inner side and the raised margin of the lower part; and in *Balistes* and *Ostracion* the triple dentations of the posterior part of the dorsal rim. These highly-specialized forms show little resemblance to the otoliths of the remaining order.

XXIII. Order MALACICTHYES.

This order consists of rare fishes of which it has not been possible to obtain examples.

XXIV. Order XENOPTERYGII.

In *Lepidogaster gouanii* (Pl. XXIII. fig. 6)—family Gobiesocidæ—the sagitta is of the Percid type, and resembles that of *Gerres rhombeus* * of the suborder Percoidea in the blunt rostrum, pointed antirostrum, shape of excisura, and in the cauda. It differs in the ventral rim, which is deepest posteriorly, and in the dorsal and posterior rims, which resemble those of *Smaris australis* †, also of the Percoidea. In the example examined the ostium is undefined.

XXV. Order HAPLODOCI.

In the order Haplodoci, recently separated from the order Pediculati by Dr. Tate Regan, the otoliths resemble each other very closely and show no resemblance to those of the Pediculati. In their general features they resemble in a striking manner the otoliths of the family Macruridæ of the order Anacanthini, differing, however, in the longitudinal curvature, which in *Batrachoides* is so great as to give a curled appearance to the otoliths.

Suborder BATRACHOIDEA.

In *Opsanus tau* (Pl. XXIII. fig. 7)—family Batrachoididæ—the sagitta shows a marked resemblance to the otoliths of the order Anacanthini. The shape is ovate and curved, and the outer side is curved and umbonated, resembling that of a young example of *Gadus morrhua.* The inner side is convex, and, except for this, the outline and general features resemble those of the otoliths of *Macrurus cœlorhynchus* ‡ of the family Macruridæ. The dorsal rim is high in front and the posterior part is curved; the ventral rim is curved and regular; the posterior rim is pointed and slightly beak-shaped; and the anterior rim is rounded and contains a small rostrum. The sulcus is biovate, enclosed, and divided by an upper and lower angle. The ostium is smaller than the cauda and is situated higher; it does not reach the anterior rim. The cauda is ovate and pointed and does not reach the posterior rim. A crest encloses the sulcus, and a deep groove traverses the otolith above the ventral rim.

In *Batrachoides surinamensis* (Pl. XXIII. fig. 8), of the same family, the sagitta resembles that of *Opsanus*, the

* Frost, Ann. & Mag. Nat. Hist. ser. 9, vol. xx. pl. v. fig. 10 (1927).
† *Id. loc. cit.* fig. 11.
‡ *Id. op. cit.* vol. xviii. pl. xxii. fig. 3 (1926).

curvature being about the same. It differs in the lower dorsal rim, in the irregular anterior rim, in the shallow ventral rim, and in the symmetrically-pointed posterior rim, which forms an angle with the dorsal rim. It also differs in the sulcus, which is without angles, though with a median constriction; the cauda is depressed, is longer than the ostium, and the end is rounded.

The sagitta of *Batrachoides cryptocentrus* (Pl. XXIII. fig. 9) is remarkable for the intense longitudinal curvature, which has the effect of giving it a curled appearance. It resembles that of *Opsanus* in the anterior and posterior projections, the latter not showing in the illustration owing to the curl of the otolith. It differs in the large deeply-excavated ostium and in the depression above the upper angle of the sulcus; the lower angle is posteriorly placed, but the cauda otherwise resembles that of *B. surinamensis.*

XXVI. Order PEDICULATI.

Suborder Lophioidea.

The sagitta of *Lophius piscatorius* (Pl. XXIII. fig. 10), of the family Lophiidæ, is highly specialized and resembles in shape the shell of a bivalve. The outer rim is flat with radiating furrows, and the inner side is concave with fine radiating lines from the centre to the dorsal rim. The lower part of the inner side is raised, and a raised band runs forward and upward to the dorsal rim; if these raised portions may be presumed to form the lower margin of the sulcus, which otherwise is not indicated, the ostium emerges on the dorsal rim. The outline of the otolith is ovate and narrow anteriorly; the dorsal rim is dentated, the ventral rim is curved, the posterior rim is rounded or pointed, and the small anterior rim is rounded.

Suborder Antennarioidea.

In *Chaunax pictus* (Pl. XXIII. fig. 11), of the family Chaunacidæ, the sagitta resembles that of *Lophius* in the raised ventral and anterior areas. It differs in the upper part of the inner side, which slopes from the dorsal rim to a crest above the sulcus. The shape is oblong, and both sides are flat, the inner side being slightly raised medianly; the dorsal rim has two prominent triangular processes, of which the posterior is the higher, and the anterior part of [illegible] is straight; the posterior rim is perpendicular; the

ventral rim is slightly curved and forms a rounded angle with the upright anterior rim. The sulcus resembles that in the otoliths of the family Congridæ of the order Apodes, and opens on the dorsal rim; the ostium is distended ventrally and towards the anterior rim; the cauda is slightly oblique, the lower margin being raised medianly and the end is rounded.

In *Antennarius nummifer* (Pl. XXIII. fig. 12), of the family Antennariidæ, the sagitta is rhomboidal in shape and is flat on both sides, the dorsal rim is nearly straight and posteriorly is curved, passing into the oblique posterior rim; the ventral rim is straight and prolonged; the anterior rim contains ablunt rostrum, above which it is concave and below is oblique; it forms an angle with the ventral rim. The sulcus is oblique and shallow, and with an angle of the lower line. The ostium is narrower than the cauda; it is constricted anteriorly and reaches the front of the otolith at the junction of the dorsal and anterior rims, as in *Chaunax*, which it also resembles in the position of the rounded cauda.

Suborder Ceratioidea.

It has been possible to obtain examples of these deep-sea fishes.

XXVII. Order OPISTHOMI.

In *Mastacembelus armatus* (Pl. XXIII. fig. 13), of the family Mastacembelidæ, the sagitta is of the Percid type and is very small relatively to the size of the fish. The shape is ovate and both sides are flat; the dorsal rim is highest in its posterior part and forms an angle with the posterior rim, anteriorly it is low and slopes to the point of the antirostrum; the ventral rim is regular and curved, the posterior rim is oblique and pointed, and the anterior rim contains a short broad rostrum, a small pointed antirostrum, and a shallow excisura. The sulcus opens widely on the anterior rim and has an upper and a lower angle; the upper margin of the ostium is distended, and the lower line is straight and slightly inclined downwards towards the anterior rim; the cauda is straight and uniformly wide, the end being slightly inclined downwards and not reaching the posterior rim.

The above concludes the "Comparative Study of the Otoliths of the Neopterygian Fishes," which has been arranged according to the classification of Dr. Tate Regan. In view of the enormous number of the species of fishes, it

has been necessary to confine the descriptions and illustrations to represent examples of the various orders and suborders, selecting as far as possible those in which the distinguishing features are best defined. The collection forming the basis of the foregoing work has taken twenty-five years to get together, and, in addition to the otoliths of recent species, contains a large number of fossil forms of great rarity, many of which have been described by the author.

I wish to acknowledge with grateful thanks material received from the British Museum, Nat. Hist. Dept.; the Smithsonian Institute, Washington; the Marine Fish Hatchery and Biological Station, Dunedin; the Scripps Marine Station, La Jolla, California; from Professor Raffaele Issel, Professor David Starr Jordan, Dr. H. C. Delsman, Professor K. Kishinouye, Dr. Marley Bell, Professor F. Wood Jones, Professor Johs. Schmidt, and many others.

I also wish to acknowledge most gratefully the assistance I have received from Dr. C. Tate Regan, F.R.S., Director of the British Museum (Nat. Hist.), to whom I owe the inception of the idea of this work and who has kindly read and corrected many of the papers; and, lastly, the assistance I have received from Mr. J. R. Norman, of the Department of Fishes, British Museum (Nat. Hist.), who has read and corrected the entire series, and has afforded me invaluable help in checking the names of the species, and in placing them in their correct positions in the various orders.

Summary.

1. The otoliths of the orders Discocephali, Xenopterygii, and Opisthomi resemble those of the Percid type.

2. Those of the order Haplodoci show a marked resemblance to the otoliths of the family Macruridæ of the order Anacanthini, differing, however, in their greater curvature.

3. In the order Pediculati the otoliths of the suborder Lophioidea are aberrant, that of *Lophius* resembling the interior aspect of the shell of a bivalve. In the suborder Antennarioidea the sagitta resembles in the sulcus those of the family Congridæ of the order Apodes.

4. It has proved impossible to obtain examples of the order Malacichthyes, or of the suborder Ceratioidea of the order Pediculati, in both cases the fishes concerned being of great rarity.

"Jericho, 19.8.29," having been sent to the Imperial Bureau of Entomology by the Government Entomologist, Palestine.

In the British Museum there are specimens of *E. uvarovi* from Baghdad, Daurah on river Tigris, "Turkey" (apparently Mesopotamia), and from Baltistan, India. The species must occur in Persia as well.

EXPLANATION OF PLATE XXIV.

Fig. 1. *Microthespis dmitrievi,* Werner. × 1·8.
Fig. 2. *Iris nana,* sp. n. × 1·8.

LXV.—*The Humble-bees captured on the Expeditions to Mt. Everest* (*Hymenoptera,* Bombidæ). By O. W. Richards, M.A.

Through the kindness of Dr. J. Waterston, of the British Museum, I have been able to study the large collection of humble-bees obtained by Major R. W. G. Hingston on the third Mt. Everest Expedition (1924) and the few which were captured on the second Expedition (1921). All the material dealt with in the present paper is in the collection of the British Museum, except that a few additional records are included, derived from material seen in the U.S. National Museum, where every facility for examination was given me by Miss G. Sandhouse, and from a few specimens kindly lent by Dr. T. H. Frison, of the State Natural History Survey, Urbana, Illinois.

The examination of these bees has been very interesting, not so much in the new forms discovered as because, owing to the large numbers of Smith's types in the collection of the British Museum, it has been possible to fix the subgeneric position of many well-known Oriental humble-bees, previously insufficiently described.

Bombus, Latreille.

Subgen. Mendacibombus, Skorikov (1914 *a*).

I take the present opportunity to describe several forms of this subgenus found in the Himalayas and in the adjacent hills.

1. *Bombus waltoni,* Cockerell (1910).

Bombus mendax, Gerst., var., Morawitz (1886, p. 199).
Bombus mendax, subsp. *chinensis,* Skorikov (1910), nec *B. chinensis,* Dalla Torre, 1890.
Bombus rufitarsis, Friese (1913).
Bombus waltoni, Skorikov (1914 *a*).

The above synonomy is mainly due to Skorikov (1914 *a*).

Recorded by Morawitz from the basin of the Yellow River and from the Burchan-Budda Mts. (13,500–14,000 ft.). Cockerell described his species from a female captured at Khamba Jong, Sikkim, 15,000–16,000 ft., 13–30 July, 1903, on the Tibet Expedition. Friese described his *B. rufitarsis* from "Central Asia." Skorikov (1910) records it from the Burchan-Budda and Sinin Mts. On the third Mt. Everest Expedition Major Hingston captured four females, viz., three Phuse La, Tibet, 16,000 ft. (two 19 June and one 3 July, 1924), and one Rongbuk, Tibet, 15,000 ft., 15 June, 1924. Evidently the species is confined to very high altitudes like the related European *B. mendax*, Gerst. Skorikov (1914 *a*) has pointed out that there is a significant difference in head-length between these two species, and this, with the constant difference in colour, appears to me to be sufficient warrant for keeping the species separate.

Skorikov (1912) described a variety of the male from Lake Kuku-Nora, which he named var. *kozloviellus*. In this variety none of the hairs of the apical abdominal tergites are red, but all are black with white tips. Friese (1924) has redescribed this variety from Tippeti, Mongolia, under the name of *B. asellus*.

Skorikov (1914 *a*) has described two other species even more closely allied to *B. mendax*. It is very difficult to identify these species with complete certainty amongst the material I have seen, especially without comparison with authoritatively named specimens; I believe, however, I can recognize his *B. avinoviellus*, though its structural differences are very slight. It is, perhaps, better considered a subspecies of *B. mendax*, like the two forms next considered.

2. *Bombus mendax*, Gerstaecker (1869).

(*a*) Subsp. *marussinus*, Skorikov (1910).

Described from the Eastern Pamirs; there is a female from Tagdumbash, Pamir, 13,000 ft., 11 June, 1894, W. J. Abbott, in the collection of the United States National Museum. The pattern is as follows:—The hairs are black; those of the head, except a few above the antennæ and on each side of the occiput, of the whole mesonotum, pleura, sternum, and venter, the hairs of the first two abdominal tergites, whitish ochreous; those of third tergite black; of the fourth to sixth dark red; hairs of the legs, except the four anterior tibiæ, a few at the apex of the corbiculæ, and some on the femora, especially the four anterior femora on their upper side, pale yellow; wings hyaline; hairs long, [illegible] uneven,

(*b*) Subsp. *himalayanus*, Skorikov (1914 *a*).

Described from one female, Kordong Pass, Himalayas, 4500 m. (15,000 ft.), 3 July, 1912, and an almost similar male from Killian, on the northern slopes of the Raskem Chain, 6500 ft., 29 Aug., 1912.

A worker from Baltistan, in the collection of the British Museum, appears to belong to this subspecies. Its pattern is as follows:—The hairs are black; those of the thorax, except for an ill-defined interalar band, which is narrower than the collar, the sternum in part, and the posterior third of the pleura bright yellow; hairs of the first two abdominal tergites bright yellow; of the third black; of the fourth to sixth red; hairs of the venter and trochanters mainly pale, of the rest of the legs black; wings hyaline; hairs rather long and uneven.

In the typical *himalayanus* the head is mainly pale-haired and the venter is black-haired. Further material may justify the separation of these forms.

3. *Bombus avinoviellus*, Skorikov (1914 *a*).

Described from several localities on the river Sindu in the Himalayas. A worker in the collection of the British Museum, captured by Lt.-Col. F. W. Thomson at Gulmarg, Kashmir, summer 1913, is nearly typical. Its pattern is as follows:—The hairs are black; a few between the antennæ, those of the whole thorax, except an intermixture of black on the disc of the mesonotum, of the first abdominal tergite, and of a basal lunule on the second, snow-white; the rest of the second tergite black, of the third red and black mixed, of the fourth to sixth rather dark red; hairs of the venter and trochanters mainly pale, legs otherwise with black hairs; wings hyaline; hairs short and even.

This species was not recorded by Skorikov from altitudes higher than 3000 m. (10,000 ft.), and the shorter hairs are probably correlated with the lower elevation inhabited. The specimen just described does not agree at every point with Skorikov's account; according to him only a narrow posterior margin of the third abdominal tergite should be red-haired. The British Museum specimen, in the extension of the white hairs of the dorsum of the thorax, approaches the var. *eriophoroides*, Skorikov (1914 *a*).

Var. nov. *subtunicatus*.

The hairs are black; a broad thoracic collar, about as broad as the black interalar band, nearly all the sternum, scutellum, and postscutellum, the hairs of the first abdominal

tergite and a broad basal lunule on the second, snow-white; of the rest of the second and the whole of the third black; of the fourth to the sixth rather dark red; hairs of the venter and trochanters white, of the rest of the legs black; wings distinctly infuscate; hairs rather short and even. The variety differs from the typical form in the darker wings, better-defined interalar black band, and the absence of red hairs from the third tergite. In these characters it has an extraordinary colour-resemblance to the unrelated *B. tunicatus*, Sm., which occurs in the same locality.

Type, one worker, Kashmir, 8000–9000 ft., June 1901 (*Col. C. G. Nurse*), in the collection of the British Museum.

The slight structural differences of these forms of *Mendacibombus* are as follows:—

(1) *B. waltoni*, Ckll.—Malar space longest; labral tubercles fused to form a continuous rounded ridge; clypeus least punctured.

(2) *B. mendax*, Gerst. — Malar space of intermediate length; labral tubercles more separated; clypeus more punctured.

(3) *B. mendax*, subsp. *marussinus*, Skor.—Like *B. mendax*, but clypeus more strongly punctured.

(4) *B. avinoviellus*, Skor.—Like *B. mendax*, but malar space slightly shorter.

Subgen. Alpigenobombus, Skorikov (1914 *a*) = [*Mastrucatobombus*, Krüger (1917)].

4. *Bombus genalis*, Friese (1918).

[=*Bombus eximius*, Handl. (1888), nec Smith (1852).]

This species was described from workers and females taken in Sikkim. On the Everest Expedition one female was captured at Tauntang, Sikkim, 6000 ft., 24 April 1924. There are the following further specimens in the collection of the British Museum:—1 ♀, Sikkim (*Lt.-Col. C. G. Nurse*); 1 ♀, 2 ☿, Gantok, Sikkim, 24 to 26 June, 1903 (Tibet expedition); 1 ♀, Khasia Hills. In the U.S. National Museum at Washington there are, further, 1 ♀, 1 ☿, Gantok, Sikkim, 24 to 26 June, 1903 (Tibet Expedition).

5. *Bombus tetrachromus*, Cockerell (1909).

[=*Bombus pulcherrimus*, Skorikov (1914 *a*); =*B. mastrucatus*, Gerst., var., Morawitz (1880, p. 202).]

This species was described from one female in the collection of the British Museum taken in Baltistan, and has the

following colour-pattern:—The hairs are black; thoracic collar of medium width, rather wider than the black interalar band, and extending to a little below the anterior spiracle; scutellum except anteriorly, postscutellum, and the hairs of the first abdominal tergite white; those of the second abdominal tergite bright yellow; base of the third narrowly black, the rest of it and the fourth and fifth pale orange-red; the sides of the fourth and the whole of the fifth with some white hairs intermixed and many of the red hairs white-tipped; hairs of the underside except quite laterally and of the legs dark; wings slightly infuscate; hairs long, fairly even (about as in *B. mastrucatus*, Gerst.). There are no specimens in the British Museum collection which exactly resemble the type; all the others have longer and shaggier hairs, and have the white thoracic collar prolonged right on to the sternum, while the sides of the second abdominal tergite are white-haired. The Baltistan form may be a special race. Of the long-haired Tibetan form, which has been described by Skorikov (1914 *a*) as *B. pulcherrimus*, the following specimens were captured on the Everest Expedition:—1 ♀, Tasam, Rongshar Valley, Tibet, 12,000 ft., 20 June, 1924; 1 ☿, Gautsa, Tibet, 11,500 ft., 21 July, 1924. The British Museum has the following further examples:—3 ♀, captured between Phari (15,000 ft.) and Gyangtse (13,000 ft.), Tibet, June 1904 (*H. J. Walton*, Tibet Expedition) (there is another female with the data of the preceding in the U.S. Nat. Mus.); 1 ♀, Khamba Jong, Sikkim, 15,000–16,000 ft., 15 to 30 July, 1903 (Tibet Expedition). Skorikov's name may be used for this variety.

Friese and von Wagner (1909) have described two forms of the allied *B. mastrucatus*, Gerst., from Kashmir, viz., var. *stramineus* and var. *kashmirensis*. The former, of which there is a female, caught in Kashmir by Lt.-Col. Nurse and identified by Friese, in the collection of the British Museum, is black; collar white; first two abdominal tergites light yellow; third black; tail red. The second variety is described as black, with the collar and first two abdominal tergites white, third black; tail red. There is a form of *B. tetrachromus*, Ckll., which has some resemblance to these varieties. It differs from both of them in its larger size, longer hairs, and in the paler red of the tail, which is somewhat white mixed. This variety, for which I propose the name *albohirtus*, n. var., has a colour-pattern like the typical form, but the two first abdominal tergites have very pale yellow (nearly white) hairs.

Type, 1 ♀, Phari, Tibet, 16,000 ft., 16 July, 1924 (third

Mt. Everest Expedition). Paratypes, 1 ♀, with the same data as the type; 1 ♀, Khamba Jong, Sikkim, 15,000–16,000 ft., 15 to 30 July, 1903 (Tibet Expedition). Skorikov (1914 *a*) has also described a variety *albidocaudatus*, in which the second tergite is black-haired.

Subgen. Rufipedibombus, Skorikov (1922).

6. *Bombus festivus*, Smith (1861).

I have examined the type of this species in the British Museum collection, and, though I have seen no males, I cannot doubt that it belongs to the same group as *B. rufipes*, Lep. *B. melaleucus*, Handlirsch (1888), with the thorax entirely black, is perhaps a variety, though I have seen nothing like it. *B. melaleucus*, subsp. *discolor*, Friese (1905), I regard as certainly identical with Smith's species. The former species was described from two females of unknown locality; the var. *discolor* from numerous western Chinese specimens and from one taken in Sikkim. On the Everest Expedition three females were obtained in Tibet—one in the Chumba Valley, 11,000 ft., 2 April, and two, Rongshar Valley, one 11,000 ft., 27 June, the other 12,000 ft., 30 June, 1924.

Subgen. Orientalibombus, Richards (1929 *b*).

7. *Bombus orientalis*, Smith (1854).

On the third Mt. Everest Expedition, 1924, Major Hingston caught three ♀ in Sikkim—one Gantok, 5000 ft., 10 April; one Kalimpong, 4000 ft., 26 March; one Tauntang, 6000 ft., 22 April. Further, one ☿ of the variety *buccinatoris*, Smith (1879), was obtained at Gantok, 6000 ft., 22 April.

Subgen. Lapidariobombus, Vogt (1911).

8. *Bombus tenellus*, Friese (1913).

[?=*Bombus bizonatus*, Smith (1878), type at Calcutta.]

This species was described by Friese as *B. lapidarius*, L., var. *tenellus*, from 2 ♀, some workers, and 1 ♂, from Sajan, Arasagun-Gol, Central Asia. It is most closely allied to *B. alticola*, Kriechb., in which, however, the corbicular hairs are red (not black), the yellow thoracic collar is narrower, the second abdominal tergite is not entirely covered with [illegible] hairs, and the hairs are rather longer and more

uneven. *B. tenellus*, Friese, is best regarded as a distinct species representative of the group in the Himalayas. On the third Mt. Everest Expedition the following specimens were caught:—2 ♀, Shekhar, Tibet, 14,500 ft., 9 July; 2 ♀, Tingri, Tibet, 15,000 ft., one 8 July and the other 14 July; 1 ♀, Lamna La, Tibet, 17,000 ft., 17 June; 3 ☿, Chiblung, Tibet, 14,500 ft., 12 July. In the British Museum collection there are the following further specimens:—1 ♀, Phung Chu Valley, Tibet, 14,000 ft., 11 June 1921 (*T. G. Longstaff*); 5 ♀, camp above the Rhumbu Glacier, Tibet, up to 18,500 ft., July 1921 (second Mt. Everest Expedition); and the following captured by H. J. Walton on the Tibet Expedition; 10 ♀, Khamba Jong, Sikkim, 15,000–16,000 ft., June 1904; 1 ♀, Phari (15,000 ft.) to Gyangtse (13,000 ft.), Tibet, June, 1904; 2 ♀ and 3 ☿, Gyangtse, Tibet, 13,000 ft., June 1904.

In the U.S. National Museum there are 1 ☿ from Gyangtse and 1 ♀ taken between Phari and Gyangtse. This species is probably referred to by Morawitz (1880, p. 200) as a variety of *B. lapidarius*, L.

In the Pamirs a variety (probably geographical race) of this species occurs in which the yellow hairs are much paler and the collar produced further down the pleura. In this form the pattern is as follows:—The hairs are black; a broad thoracic collar, extending two-thirds of the way down to the sternum and spreading under the wings and rather broader than the black interalar band, scutellum, post-scutellum, and the hairs of the first two abdominal tergites, pale yellow, almost creamy white; those of the third tergite black; of the fourth to sixth rather pale red; legs and venter black-haired, hairs of fourth to sixth sternites rather paler; wings subhyaline; hairs rather short and even. Length 25 mm.; width between the tegulæ 8 mm.

Var. nov. *alpivagus*.

The type of this variety is a female in the collection of the British Museum, captured at Taghdumbash, Pamir, 14,000 ft., 18 June, 1913, by Major R. W. G. Hingston. Paratypes, two more females from the same locality, one caught on 13 and the other on 19 July, 1913, by Major Hingston. A worker in the collection of the U.S. National Museum, Washington, probably belongs to this variety. It differs in having the hairs of the four anterior trochanters and some of those on the base of the hind femora pale and in having the hairs somewhat longer. This specimen was

captured on the Huen Luen Mts., near Kukiar, E. Turkestan, 9000 ft., 30 July, 1894, by W. J. Abbott.

9. *Bombus tanguticus*, Morawitz (1880).

A very large bee, allied to *B. lapidarius*, L., appears to be *B. tanguticus*, Mor., originally found in the basin of the Yellow River, 13,500 ft. The structure of the labrum agrees with Morawitz's (*loc. cit.*) description, and the colour-pattern is the same.

Female.—The hairs are black; a broad thoracic collar, considerably broader than the black interalar band, and extending downwards to the anterior thoracic spiracle, the scutellum and postscutellum, and the first and second abdominal tergites, with pale yellow hairs; those of the third black, with some of the apical ones reddish or whitish tipped; of the fourth and fifth pale red (much paler than in *B. lapidarius* or *B. tenellus*), some of the hairs white-tipped; hairs of the underside and legs entirely black; wings subhyaline; hairs long, fairly even. Length 28 mm.; breadth between the tegulæ 10 mm.

Mandibles with the sulcus obliquus poorly developed, no incisura lateralis; tubercles of the labrum elongate, so that the furrow is only a notch between them, inner part of the tubercles densely alutaceous, more laterally with a smooth area; malar space slightly longer than broad (about as in *B. lapidarius*), as long as the third together with half the fourth joint of the antennæ; clypeus irregularly punctured all over, the punctures being of various sizes; the apical depressions very deep, meeting broadly centrally, strongly punctured; third joint of the antennæ about one and a half times as long as the fourth, but much shorter than the fourth and fifth together; mid-metatarsi not produced into a spine; sixth abdominal tergite with a raised rounded bare area (as in *B. lapidarius*), this area more or less furrowed apically; sixth sternite not keeled.

Compared with *B. tenellus*, Friese, it is much larger (length 28 mm., not 20 mm.), the hairs are rather longer, and the yellow thoracic collar is rather broader, instead of narrower, than the black interalar band. In *B. tenellus*, also, the labral furrow is two-thirds as wide as a tubercle.

1 ♀, camp above the Rhumbu Glacier, Tibet, up to 18,500 ft., July 1921 (second Mount Everest Expedition); 1 ♀, Kampa Dzong, Tibet, 15,000 ft., 17 July, 1924, and 2 ♀, Phari, Tibet, 16,000 ft., 19 July, 1924 (third Mt. Everest Expedition); 2 ♀, Gantok, Sikkim, 24 to 26 June, 1903 ([illegible] Expedition).

10. *Bombus rufofasciatus*, Smith (1852).

This species belongs to the group Skorikov (1922) has called *Kozlovibombus*, which I regard as merely a subgroup of *Lapidariobombus*. Handlirsch (1888) has already pointed out that *B. rufocinctus*, Morawitz (1880) (nec Cresson, 1863, = *B. chinensis*, Dalla Torre, 1890), is a synonym. A careful study of Morawitz's description of his *B. prshewalskyi* (1880) convinces me that that form, too, is only a colour-variant of *B. rufofasciatus*; the description agrees not only in the colour, but in the structural details, including the male genitalia.

The type of *B. rufofasciatus*, Smith, is a female from "N. India" in the collection of the British Museum, and has the following colour-pattern:—The hairs are black; a thoracic collar about two-thirds as wide as the black interalar band, extending almost to the sternum and broadening beneath the wings, the posterior part of the postscutellum, and the hairs of the first abdominal tergite white; of the second and the base and sides of the third narrowly black; the rest of the third red; the fourth similar but paler, and grading apically into white; the fifth and the long hairs of the sixth white; hairs of the venter nearly all black; the wings subhyaline; the hairs rather short and even.

Although in the actual type the hairs of the base of the fourth tergite are pink, in most specimens they are all or nearly all white.

In a recent paper (1928 *a*) I described a variety *championi* of this species, and in (1928 *b*) two further varieties, vars. *rufior* and *ladakhensis*. Further study shows that there is in reality an additional distinct colour-pattern intermediate between the two first varieties. The variety *championi* I believe to be synonymous with the form described as *B. prshewalskyi* by Morawitz (1880). The following key indicates the main features of the colour-variation in the females and workers:—

1 (10). Hairs of the first abdominal tergite white.

2 (3). Hairs of the second abdominal tergite black. (Fourth tergite mainly white-haired; little black on the base of the third.) .... *B. rufofasciatus*, Smith [(type).

3 (2). Hairs of the second abdominal tergite white or yellow.

4 (5). Hairs of the second abdominal tergite white. (The rest of the pattern like that of the type-form.) .... Var. *phariensis*, nov.

5 (4). Hairs of the second abdominal tergite mainly yellow. (Sometimes partly black.)
6 (7). Hairs of fourth abdominal tergite white or very pale red, grading into white .... Var. *prshewalskyi*, Morawitz (=var. *championi*, Richards, in part.).
7 (6). Hairs of the fourth abdominal tergite mainly bright red.
8 (9). Hairs of the apex of the second and of the base of the third abdominal tergite black; the rest of the third and and the whole of the fourth bright red .... Var. *intermedius*, nov. (=part of vars. *championi* and *rufior*, Richards).
9 (8). Hairs of the second abdominal tergite yellow, of the third and fourth entirely bright red .... Var. *rufior*, Richards.
10 (1). Hairs of the first abdominal tergite yellow. (Collar also yellow; third tergite red, fourth red, grading into white.) .... Var. *ladakhensis*, [Richards.

Var. *phariensis*, nov.

The colour-pattern resembles that of the typical form, but the second abdominal tergite is white-haired except for a few black hairs on the disc and a narrow apical band.

Type, female, Phari (15,000 ft.) to Gyangtse (13,000 ft.), Tibet, June 1904 (*H. J. Walton*, Tibet Expedition). Paratypes, two further females with the same data and a male allotype from Gyangtse, Tibet, 13,000 ft., June 1904 (*H. J. Walton*, Tibet Expedition). The pattern of the male resembles that of the female, but the hairs of the clypeus and a few on the vertex are white; the hairs of the third and fourth abdominal tergites are red, and of the fifth to seventh white, those of thesixth and seventh being much black-mixed.

Var. *prshewalskyi*, Morawitz
(=*championi*, Richards, in part.).

Of the specimens described as var. *championi* in (1928 *a*) only the type ♀, Kashmir, 8000–9000 ft., June 1901 (*Lt.-Col. C. G. Nurse*), and a worker, Khamba Jong, Sikkim, 15,000–16,000 ft., 15–30 June, 1903 (Tibet Expedition), fall under the var. *prshewalskyi* as here limited. The other specimens come under my new variety, *intermedius*. There is a further worker of the var. *preshwalskyi* in the U.S. Nat. Mus. at Washington; this specimen came from Gyangtse, Tibet, 13,000 ft., June 1903 (*H. J. Walton*, Tibet Expedition).

Var. *intermedius*, nov.

This resembles the typical form, but there are more black hairs at the apex of the second and the base of third abdominal tergites, and the hairs of the fourth abdominal tergite are bright red.

Type, worker, Shekhar, Tibet, 14,000 ft., 9 July, 1924 (third Mt. Everest Expedition) (specimen mentioned under var. *rufior* in 1928 *b*). Paratypes (quoted under var. *championi* in 1928 *a*), 1 ☿, Shekhar, Tibet 14,000 ft., 8 July, 1924; 7 ☿, Phari, Tibet, 16,000 ft., 21 July, 1924; 1 ☿, Gautsa, Tibet, 11,500 ft., 21 July, 1924 (third Mt. Everest Expedition); 1 ☿, Khamba Jong, Sikkim, 15,000–16,000 ft., 15–30 June, 1903 (Tibet Expedition); 15 ☿ and 1 ♂, Gyangtse, Tibet, 13,000 ft., June 1904 (*H. J. Walton*, Tibet Expedition); 1 ☿, Sangcha, N. Kumaon, India, 14,000 ft. (*H. G. Champion*). The male specimen differs from the workers in having the hairs of the clypeus and vertex white, of the third abdominal tergite entirely red, of the fifth to seventh white, much black-mixed on the sixth and seventh.

Further specimens of this variety, not mentioned in any of my previous papers, are 3 ☿, Phari, Tibet, 14,000 ft., 21 July, 1924 (third Mt. Everest Expedition). A worker from Gulmarg, Kashmir, summer of 1913 (*Lt.-Col. F. W. Thomson*), is somewhat transitional to the var. *rufior*.

Var. *rufior*, Richards (1928 *b*).

Besides the specimens collected by Col. Meinertzhagen in Ladakh, I have seen one worker from Gulmarg, Kashmir, summer 1913 (*Lt.-Col. F. W. Thomson*). The specimen mentioned from Shekhar in the original description of the var. *rufior* becomes the type of the new variety *intermedius*.

Var. *ladakhensis*, Richards (1928 *b*).

This is known only from a single female collected by Col. Meinertzhagen in Ladakh.

11. *Bombus miniatus*, Bingham (1897).

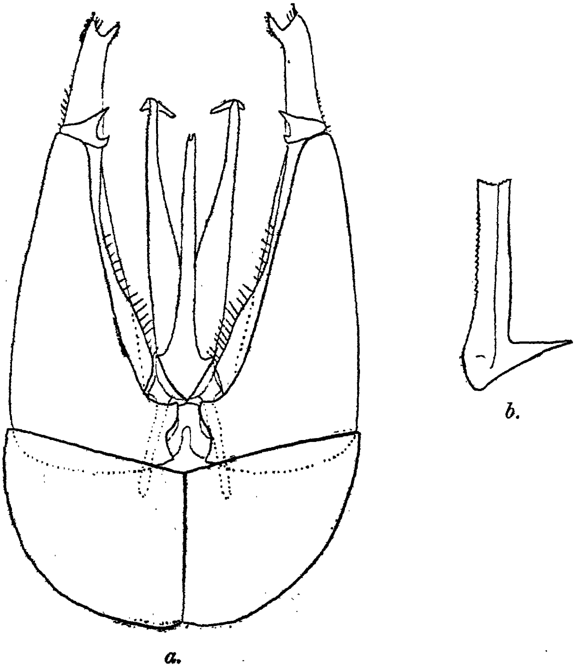
The type of this species, which I redescribe, is a unique male from Lintu, Sikkim, 12,500 ft., May 1894.

The hairs are black; those of the clypeus, a few above the antennæ, the tuft on the vertex, the whole of the thorax above, laterally, and beneath (except a few black hairs on the disc of the mesonotum), and the hairs of first two abdominal tergites bright yellow; hairs of the third to sixth dull red,

of the sixth and seventh black; hairs of the femora yellow; the venter with long yellow hairs; wings subhyaline; hairs long and uneven. Size rather large, about as big as a female of *B. agrorum*, F.

Eyes normal; ocelli removed from the eyes a distance equal to $2\frac{1}{2}$ times the width of an ocellus, lying just below the supraorbital line; malar space distinctly longer than broad, about as long as the third and half the fourth joints of the antennæ together, hardly punctured; antennæ short,

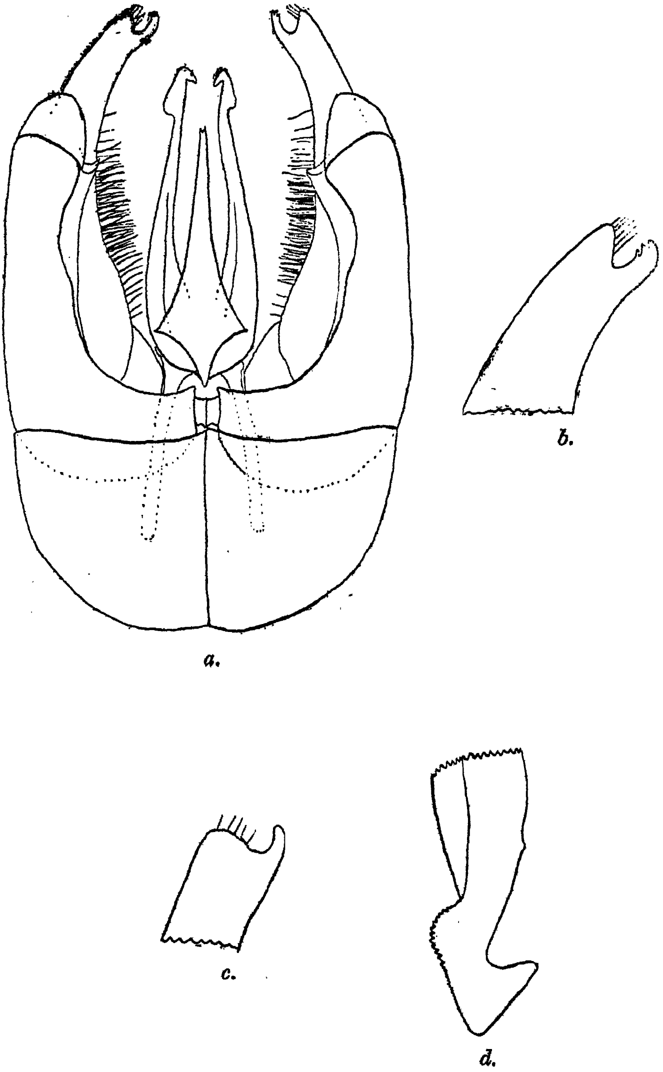
Fig. 1.



a, male genitalia of *B. miniatus*, Bingham (type), seen from above; *b*, apex of the left sagitta.

with the third joint as long as the fourth, the fifth joint, which is rather longer, twice as long as broad; the apical joint as long the penultimate, about twice as long as broad; mid-metatarsus extraordinarily elongate, five to six times longer than broad, distal posterior angle a right angle, hair-fringe of the metatarsus near the base twice as long as the joint is broad; hind tibiæ with no distinct bare space, the surface faintly alutaceous; hind metatarsi rather long and

Fig. 2.



a, male genitalia of *B. atrocinctus*, Smith (probably paratype), seen from above; *b*, apex of the right volsella, more magnified; *c*, apex of the right volsella of the male genitalia of *B. terminalis*, Smith; *d*, apex of the left sagitta of *B. terminalis*.

parallel-sided, the hair-fringe about twice as long as the joint is broad; the distal posterior angle only a very little produced; the sixth abdominal sternite slightly emarginate at the apex, which is densely hairy; genitalia (fig. 1) somewhat intermediate between those of *B. lapidarius*, L., and *B. rufofasciatus*, Smith; the squama has two inwardly directed processes, both of which are simple. In *B. rufofasciatus*, Sm., the posterior of these is bifid; in *B. lapidarius*, L., the emargination which gives rise to these two processes is almost obsolete, the processes being rudimentary. The apex of the volsella is almost identical with that of *B. rufofasciatus*, Sm., being much more deeply emarginate than in *B. lapidarius*, L. The sagittæ are much more like those of *B. lapidarius*, L., the outer edge not being expanded just before the head as in *B. rufofasciatus*, Sm., nor being so strongly serrate as in that species.

I have seen no females of this species, but three workers captured on the third Mt. Everest Expedition may belong here. The structural characteristics of these very small individuals are not at all striking; they much resemble those of *B. rufofasciatus*, Sm., but the malar space appears to be rather longer. The colour-pattern is as follows:—The hairs are black; all the shorter hairs of the head pale; thorax above, laterally, and beneath yellow considerably intermixed with black, with an ill-defined black interalar band and a small black patch just beneath the wings; the hairs of the two first abdominal tergites yellow; of the basal half of the third black, of the apical half and of the fourth and fifth deep red; the hairs of the apex of the fifth white-tipped; hairs of the venter mainly and of the ventral side of the femora pale; wings hyaline; hairs rather long and uneven. 3 ☿ Rongshar Valley, Tibet, one 11,000 ft., 28 June, one 12,000 ft., 30 June, and one (with no height given), 27 June, 1924.

12. *Bombus peralpinus*, sp. n.

The following species, of which I have seen three large workers (? females) and one small worker, I believe to be undescribed, but its exact relationships will remain doubtful until more material, particularly of the male sex, is available. In colour it resembles *B. rufofasciatus*, Sm., var. *rufior*, Richards, except for a few minor details; in structure it is also very similar.

Worker: the hairs are black; a thoracic collar less than half as broad as the black interalar band, somewhat black-mixed and extending down nearly to the sternum, a few

hairs at the back of the scutellum, the hairs of the first abdominal tergite except its disc, the sides of the second narrowly (more broadly at the apex), the sides of the third and the sides of the fourth very narrowly, white; the rest of the hairs of the second abdominal tergite pale sulphur-yellow; base of the third narrowly black, the black broader at the sides, the disco-apical part of the third bright red; the fourth, except the sides, bright red, the sides being narrowly black inside the white hairs; the fifth and the long hairs of the sixth bright red (rather more purple than in *B. lapidarius*, L.); hairs of the venter and the legs black; wings somewhat infuscate; hairs rather long and uneven.

Structurally like *B. rufofasciatus*, Sm., but the clypeus more swollen, rather heavily punctured all over, with the apical impressions very deep, deeply and almost confluently punctured. These impressions in *B. rufofasciatus*, Sm., are much less deep, and the whole clypeus is less closely punctured.

Type, worker, Tasam, Rongshar Valley, Tibet, 12,000 ft., 20 June, 1924 (*Major R. W. G. Hingston*, third Mt. Everest Expedition); paratypes, one similar worker, Rongshar Valley, 13,000 ft., 1 July; another worker with the same data, similar in size, but with the short hairs of the face pale, the collar broader, especially on the pleura, with more white on the sternum and scutellum, and the hairs of the first abdominal sternite nearly all white; venter, the four hind trochanters, and coxæ mainly, the four hind femora partly, white-haired; one small worker, Gautsa, Tibet, 11,500 ft., 21 July, like the type, but the sternum partly, the venter mainly, and the underside of the base of the legs white.

Subgen. Pratobombus, Vogt (1911).

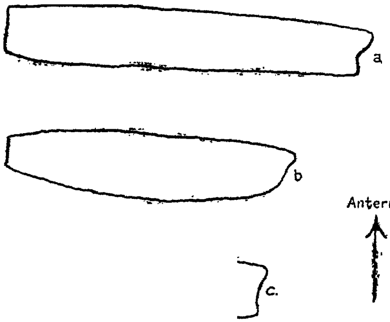
13. *Bombus atrocinctus*, Smith (1872) = *Bombus terminalis*, Smith (1872), nec Smith (1873).

According to Handlirsch (1888) both these species are merely forms of the European *B. hypnorum*, Linné (1758). Examination of the types and comparison with the latter bee shows that Handlirsch is incorrect, though Smith's two species are almost certainly only polymorphic forms of one which has exactly the same type of variation as *B. hypnorum*, L. The collection made on the second Mt. Everest Expedition provides good evidence of this, for all the males captured belonged to *B. atrocinctus* and all the females to *B. terminalis*. The type of the former species is a male from Northern India with the following colour-pattern:—The hairs are pale

orange; all the long hairs of the head, a patch on the pleura just beneath the wings, and the hairs of the third and fourth abdominal tergites black; disc of the fourth very narrowly at the apex and the fifth to the seventh white; venter practically all pale-haired; hairs of the femora and tibiæ mainly black; wings subhyaline; hairs rather short and even, distinctly shorter than in *B. hypnorum*, L.

Structurally like *B. hypnorum*, L., but the mid-metatarsus is much longer (fig. 3 *a*), with the posterior angle a little more produced. The hind tibiæ are smooth and shining, slightly convex, the surface covered with short feathery hairs besides the longer bristles. The seventh abdominal sternite ends in a rounded point instead of being truncate or slightly emarginate. The genitalia (fig. 2) differ considerably, resembling

Fig. 3.



Right mid-metatarsus of male *Bombus* species. a, *B. atrocinctus*, Smith; b, *B. atrocinctus*, var. *minutior*, Richards; c, *B. hypnorum*, L. (Norway).

in some respects those of *B. mastrucatus*, Gerst. The squama has an inwardly directed basal process; the volsella projects considerably beyond the squama and is deeply emarginate at the apex; the sagitta is not emarginate beneath near the base so as to produee an outstanding tooth, and the inwardly directed apical hooks are more broadly flanged and have two straight edges joined by a curve, instead of bending inwards in a continuous curve.

I have seen no females exactly corresponding to this male. Two females and a worker from Kashmir in the collection of the British Museum, of the same general pattern, have considerably paler ground-colour and much longer hairs, and probably represent a distinct species. Of *B. atrocinctus*, Smith, I have seen the following males:—Type and three others, probably paratypes, from Northern

India; one, without data, but probably also a paratype; 3 from the Bingham coll., 1 Lintu, Sikkim, 12,500 ft., May 1894, 1 Runjit Valley, Sikkim, 1000 ft., April 1894, and 1 Gnatong, Sikkim, 12,500 ft., May 1894 (the altitude given on the label of the second specimen is perhaps erroneous); 4 Rongshar Valley, Tibet (third Mt. Everest Expedition), 1, 10,000 ft., June 1924, and 3, 11,000 ft., 27 June, 1924; 1 Deoban, Jamsar, May 1921 (in Dr. Frison's collection).

One male caught in the Rongshar Valley, Tibet, 26 June, 1924, at 10,000 ft. (third Mt. Everest Expedition), is sufficiently different to require a varietal name.

Var. *minutior*, nov.

The hairs are rather pale orange; a few bristles on the head and a small patch under the wings black; third to the seventh abdominal tergites with the hairs pale ochreous, those at the sides of the base of the third and fourth black; a few hairs on the upperside of the four anterior pairs of femora, some of the corbicular hairs, and most of the ventral surface black; the mid-metatarsus (fig. 3 *b*) has the posterior apical angle strongly rounded away; size smaller than in other examples of *B. atrocinctus*, Sm.

The type of *B. terminalis*, Smith, is a worker from Northern India in the collection of the British Museum. The colour-pattern is as follows:—The hairs are black; the short hairs of the head pale yellowish; hairs of the mesonotum deep orange (as in *B. smithianus*, White); a few hairs on the apical disc of the fourth abdominal tergite, the whole of the fifth, and the long hairs of the sixth white; wings rather strongly infuscate; hairs rather short and even, shorter than *B. hypnorum*, L. It differs, further, from *B. hypnorum* in having the external apical angle of the hind tibiæ strongly produced.

The colour of the thorax is a much deeper orange, and the wings are much darker than in the latter species, and the pleura are dark-haired. This colour-form is almost restricted to the female sex, but I have seen one male (from Simla, Smith coll.) which is similar, except that the thorax is paler, the hairs of the first abdominal tergite are mainly pale yellow, the hairs of the femora and underside are mainly whitish. This male is structurally like that of *B. atrocinctus*, Smith, except that the inwardly directed process of the squama appears to be less developed.

I have seen the following specimens of the var. *terminalis*, Sm. :—3 ☿, including the type, from Northern India ; 4 ♀, Runjit Valley, Sikkim, 1000 ft. (*C. T. Bingham*) ; 1 ♀ and 2 ☿, Gnatong, Sikkim, 12,500 ft. (*C. T. Bingham*) (one of these being in the U.S. Nat. Mus.) ; 1 ♀, Lintu, Sikkim, 12,500 ft. (*C. T. Bingham*) ; 2 ☿, without locality, from the Bingham coll. ; 1 ☿, Sikkim (*Lt.-Col. C. G. Nurse*) ; 1 ☿, Kangra Valley, 4500 ft., June 1899 (*Dudgeon*) ; 1 ☿, Tungu, Teesta Valley, Sikkim, 13,000–14,000 ft., 1–15 July, 1903 (Tibet Expedition) ; 1 ☿, Deoban, Jamsar, May 1921 (in Dr. Frison's collection) ; and the following from the third Mt. Everest Expedition, 1924 : 1 ♀, Rongshar Valley, Tibet, 11,000 ft., 27 June ; 2 ♀, 11,000 ft., 28 June ; 1 ♀, 12,000 ft., 30 June ; and 1 ♀, Tropde, Tibet, 12,000 ft., 21 June.

14. *Bombus hypnorum*, Linné (1758).

The typical European form of this species does not appeai to occur in the Himalayas, but I have seen a single male o a variety, which much resembles *B. atrocinctus*, Smith, ir colour. The hairs of this male are rather pale orange ; onl a few of the long bristles of the head are black ; hairs o the third and fourth abdominal tergites black, the latte with a few white hairs at the apex of the disc ; hairs of th fifth to seventh white ; hairs of the legs pale, except that a few on the underside of the hind femora are black ; hairs o the underside pale whitish yellow ; wings subhyaline ; hair somewhat longer than in *B. atrocinctus*, Sm., about as i *B. hypnorum*, L.

Structurally this form resembles *B. hypnorum*, L., in al details ; it only differs from the var. *calidus*, Er., in the pale tint of the thoracic hairs in the latter. It differs fron *B. atrocinctus*, Sm., in the shorter mid-metatarsus, with a slightly less produced posterior apical angle ; in the bar concave disc to the hind tibiæ ; in the truncate sevent sternite ; in the simple squama, beyond which the scarcel emarginate volsella hardly reaches ; and in the sagittæ which are emarginate beneath near the base and have thei apical hooks bent inwards in a continuous curve.

For this Indian form, of which I have seen 1 ♂, Rongsha Valley, Tibet, 11,000 ft., 27 June, 1924 (third Mt. Evere Expedition), I propose the name *bryorum*, var. nov.

I have seen females and workers which I believe corre spond to this male.

The pattern is as follows :—The hairs are black ; som of those on the vertex pale ; the thorax pale yellow-brow

(as in *B. agrorum*, F.) ; anteriorly the pleura are pale yellow-brown almost down to the sternum ; the hairs of the first two abdominal tergites, except the disc of the second, pale yellow-brown; of the third black; of the fourth to sixth black; hairs of the venter and legs black, apex of the venter white-haired; wings uniformly rather dark; hairs long and uneven. Length 22 mm.; width between the tegulæ 9 mm.

Type, female, in the collection of the British Museum, Kashmir, 8000–9000 ft., June 1901 (*Lt.-Col. C. G. Nurse*). Paratypes, 1 ♀, with the same data (in this specimen rather more numerous hairs on the second tergite are black, as are some on the base of the fourth); 2 ☿, Gulmarg, Kashmir, summer 1913 (*Lt.-Col. F. W. Thomson*). One of these workers is in the collection of the U.S. National Museum. In the worker more of the pleura and venter is pale-haired and some of the hairs of femora may be pale.

This form differs from *B. atrocinctus*, Sm., var. *terminalis*, Sm., in the paler tint of the thoracic hairs, in the uniformly dark wings (without a deeper cloud at the apex), and in the much more strongly punctured clypeus, which, especially at the apex, has very large punctures. There is not sufficient material in the British Museum to compare this form with the numerous races of *B. hypnorum*, L., that have been described from Russia. It differs from the western European form (Germany) as follows :—the European form is slightly smaller (length 21 mm., width 8 mm.), hairs slightly shorter, those of the first two abdominal tergites being black.

Subgen. Sibiricobombus, Vogt (1911).

15. *Bombus miniatocaudatus*, Vogt (1909).

According to Skorikov (1922) probable synonyms of this species are *B. regeli*, Mor., var. *pamirensis*, Friese (1913), and *B. melanurus*, Lep., var. *apicatus*, Friese (1911); from Friese's descriptions both these identifications appear highly probable. The species has an extraordinary resemblance in certain structural features (very long malar space ; shape of the mid-metatarsi somewhat intermediate between the spinose and non-spinose types) to certain species of the subgenus *Subterraneobombus* which are found with it; it is, however, distinct from those species in lacking a furrow on the sixth abdominal tergite and in the greater nnmber of punctures on the clypeus, which lacks the central unpunctured line at its base.

Of the typical form of the species, which appears to be confined to the Pamir, Altai, and possibly other areas in Central Asia, I have seen three females, Taghdumbash, Pamir, 14 June, 1897 (*W. J. Abbott*). Two of these are in the collection of the U.S. National Museum and one in my own. The pattern is as follows:—The hairs are black; a very broad thoracic collar, rather broader than the interalar black band, and extending halfway down the pleura and back under the wings, scutellum, postscutellum, and the hairs of the first two abdominal tergites bright yellow; those of the third black; of the fourth to sixth pale red, with many white hairs mixed; hairs of the legs and venter black, of the latter pink and white towards the apex; wings subhyaline; hairs rather short and even; length 21 mm., width between the tegulæ 8 mm.

In the Himalayas a much paler form is found, for which I propose the name *falsificus*, race nov.

The pattern of this race is as follows:—The hairs are black; a broad collar, about as broad as the black interalar band and extending to the anterior spiracle, scutellum and postscutellum, and the hairs of the first two abdominal tergites pale ochreous-yellow; of the third and fourth tergites black; the apex of the fourth, the whole of the fifth and the long hairs of the sixth pale red (almost reddish white); legs dark-haired; venter dark-haired, with the hairs of the fifth and sixth sternites reddish; wings hyaline; hairs rather long, fairly even. Length 20 mm.; width between the tegulæ 8 mm.

Type, 1 ♀ (or large ☿), Tingri, Tibet, 14,000 ft., 4 July, 1924 (*Major R. W. G. Hingston*, third Mt. Everest Expedition).

Compared with *B. vorticosus*, Gerst., the hairs are much longer and the apical impressions of the clypeus are smaller and less punctured. Structurally it most resembles *B. callophenax*, Cockerell (1917), of which I have examined the type at Washington; but in that species the wings are dark and the yellow hairs are replaced by snowy white.

Besides the type, Major Hingston also captured the following specimen of *B. miniatocaudatus*, Vogt, race *falsificus*, on the third Mt. Everest Expedition:—1 small ☿, Chiblung, Tibet, 14,000 ft., 12 July, 1924. There are, further, in the collection of the British Museum, 3 ♀ (or large ☿), Gyangtse, Tibet, 13,000 ft., June 1904 (*H. J. Walton*, Tibet Expedition).

Subgen. Subteraneobombus, Vogt (1911).

A number of species of this subgenus occur in Tibet and the Himalayas. The females are characterized by the feeble development of the spine of the mid-metatarsus, by the very elongate malar space, by the furrow on the sixth tergite, and often by having a central line left unpunctured at the base of the clypeus. The following key, besides differentiating the females of this group which occur in the Himalayas, includes some of the Central Asiatic species:—

1 (6). Malar space shorter, not as long as the second, third, and fourth joints of the antennæ together, and sometimes considerably punctured. Apical impressions of the clypeus closely and deeply punctured; no central impressed line at the base.

2 (3). Clypeus finely punctured all over; the apical depressions not defined. Malar space hardly punctured. Thorax entirely yellow-haired, the colour deep ochreous. Wings dark. First two tergites yellow-haired. Hairs very short .... *B. fragrans*, Pallas (1771).

3 (2). A large discal area of the clypeus hardly punctured; the apical impressions small but deep. Malar space with fairly numerous punctures. Dorsum of the thorax with a black band between the wings; hairs of the first three abdominal tergites yellow.

4 (5). The yellow of the thorax and abdomen deep ochreous; wings (apparently) dark .... **B. flaviventris*, Friese [(1905).

5 (4). The yellow of the thorax and abdomen very pale; wings hyaline .... *B. flaviventris*, Friese, subsp. [*ochrobasis*, nov.

6 (1). Malar space longer, nearly as long as the third, fourth, and fifth antennal joints together. Apical impressions of the clypeus obsolete; the central unpunctured line at the base present or (*B. personatus*) indicated.

7 (16). Tail black-haired. The obsolete impressions of the clypeus hardly punctured except at the extreme apical margin.

8 (9). Clypeus flatter and more punctured. Colour like *B. melanurus*, Lep., but there is often a considerable number of black hairs indicating a black interalar band; when these black hairs are few or absent the third abdominal tergite often has some or many yellow hairs. *B. *fedtschenkoi*, Morawitz (1875).

9 (8). Clypeus flatter and less punctured; colour-pattern usually different.

10 (13). A band of black hairs between the wings.

11 (12). Wings dark. The yellow hairs of the thorax and the anterior abdominal tergites deep ochreous. *B. *tschitscherini*, Radoszkovsky (1862).

12 (11). Wings hyaline. The yellow hairs of the thorax and the anterior abdominal tergites creamy white B. *difficillimus*, Skorikov (1912).

13 (10). Dorsum of the thorax entirely ochreous-haired.

14 (15). Wings blackish brown. Occiput behind and at the sides of the ocelli duller and more closely punctured .... B. *melanurus*, Lepeletier (1836).

15 (14). Wings pale brown to hyaline. The occiput more shining and less punctured .... B. *melanurus*, subsp. *subdistinctus*, Richards (1928*b*).

16 (7). Each tergite of the tail with the hairs of its base black and of its apex white. Clypeus with more numerous punctures, which are very fine on the disc; the apical impressions equally obsolete, but replaced by quite extensive punctured areas. A black interalar band present.

17 (18). The pale hairs of the thorax and of the base of the abdomen creamy white or very pale ochreous.................... B. *personatus*, Smith (1879).

18 (17). The pale hairs of the thorax and of the base of the abdomen yellow .... *B. *roborowskyi*, Morawitz (1886).

The species marked with an asterisk are those which I have not been able to examine; in these the key is correct as regards colour (at least so far as the original descriptions allow), but I cannot answer for the small structural differences. *B. fedtschenkoi*, Mor., has been distinguished from its close ally *B. melanurus*, Lep., by Skorikov (1914*b*), but it appears to require a careful comparison with other eastern [illegible] of the subgenus. *B. roborowskyi*, Mor., has the

same relation in colour-pattern to *B. personatus*, Sm., as *B. tschitscherini*, Rad., has to *B. difficillimus*, Skor.

16. *Bombus flaviventris*, Friese, subsp. *ochrobasis*, nov.

Friese's description of his species (1905) is very unsatisfactory, since he only gives the differences from *B. tschitscherini*, Rad. It is possible that the form he thought to be the latter was really the later-described *B. difficillimus*, Skorikov, in which case my subspecies would be the same as Friese's species. I think, however, this is unlikely, since the latter was described from Central Asia, where deep ochreous rather than very pale ochreous is the usual colour for the subgenus. The subspecies has the following pattern:—The hairs are black; a very broad thoracic collar, rather broader than the black interalar band and extending below the anterior spiracle, scutellum and postscutellum, and the hairs of the first three abdominal tergites pale yellowish white; the hairs of the rest of the tail, of the venter, and of the legs black; wings hyaline; hairs of medium length, fairly even.

Size: length 21 mm.; breadth between the tegulæ 8 mm.

Type, female, Khamba Jong, Sikkim, 15,000–16,000 ft., 15–30 July, 1903 (Tibet Expedition); paratypes, 2 ♀ and a ☿, with the same data; 3 ☿, Gyangtse, Tibet, 13,000 ft., June 1904 (from the same expedition); 3 ☿ (*Major R. W. G. Hingston*), Tibet 1924 (third Mt. Everest Expedition), viz., Tingri, 15,000 ft., July, Chiblung, 14,500 ft., 12 July, and Shekhar, 15,000 ft., July; 1 ☿, camp above the Rhumbu glacier, up to 18,500 ft., July 1921 (second Mt. Everest Expedition).

17. *Bombus difficillimus*, Skorikov (1912).

Little need be added here to what I wrote about this species in (1928 *b*). On the third Mt. Everest Expedition (1924) Major Hingston captured 2 ♀ and a ☿, Phari, Tibet, 16,000 ft., the females on 19th July and the worker on the 21st. In the collection of the U.S. Nat. Mus. at Washington is another worker from Gyangtse, Tibet. Cockerell (1922) mentions, under the name of *B. tschitscherini*, Rad., two females obtained by W. J. Abbott at Tagdumbash, Pamir, 13,000 ft., 14 June, 1894, and one worker, Doti, Rupshu, Ladakh, 15,500 ft., Aug. 1897. Skorikov described the species from a variety of eastern localities—Pamir, Alai Mts., Ladakh, Yellow River, and Kuku-nor River.

18. *Bombus personatus*, Smith (1879).

[=*Bombus difficillimus*, var. *pamirus*, Skorikov (1912).]

I have examined the type of this species, a female in the collection of the British Museum. It was described from Kanawar, N. India, and its pattern is as follows:—The hairs are black; those of the face and vertex pale and black, equally mixed; a broad collar, about as wide as the black interalar band and becoming broader beneath the wings, where it extends down to the sternum, scutellum, and postscutellum, and the hairs of the first two abdominal tergites pale yellowish white; hairs of the abdominal tergites 3–5 black, with those of the apical quarter whitish (paler than the anterior yellowish hairs); hairs of legs black, somewhat pale-mixed below the femora; venter pale-haired; wings hyaline; hairs long and fairly even.

Structurally this species is very closely allied to *B. difficillimus*, Skor., and I think that there is no doubt that Skorikov's variety *pamirus* of the latter is the same as *personatus*, Smith. The small difference in the puncturation of the clypeus given in the key (p. 654) appears, however, to be quite as constant as the colour-differences. Besides the type, I have seen the following specimens of *B. personatus*:—1 ♀, Rongshar Valley, 13,000 ft., 1 July; 1 ☿, Tinki Dzong, 15,000 ft., 13 July, Tibet (third Mt. Everest Expedition, 1924); 1 ♀ and 8 ☿, Gyangtse, 13,000 ft., June 1904; 4 ♀, Phari (15,000 ft.) to Gyangtse (13,000 ft.), June 1904, Tibet; 1 ☿, Khamba Jong, Sikkim, 15,000–16,000 ft., 15–30 July, 1903 (Tibet Expedition). Skorikov described his variety from the Pamirs.

As in *B. difficillimus*, Skor., the worker has the pale hairs of the abdomen a much brighter yellow than the female, while the white hairs of the tail are reduced; the two species may always be separated by the extensively pale pleura of *B. personatus*, Sm.

PSITHYRUS, Lepeletier.

Psithyrus rupestris, F., group.

1. *Psithyrus tibetanus*, Morawitz (1886).

One female of this species was captured at Chiblung, Tibet, 14,500 ft., 12 July, 1924 (third Mt. Everest Expedition).

Subgen. FERNALDÆPSITHYRUS, Frison (1927).

2. *Psithyrus skorikowi*, Popov (1928).

Two females of this species were captured at Phari, Tibet, 14,000 ft., 21 July, 1924 (third Mt. Everest Expedition) (see Richards, 1929 *a*).

PAPERS QUOTED.

BINGHAM, C. T. 1897. 'The Fauna of British India. Hymenoptera.—I. Wasps and Bees.' London.

COCKERELL, T. D. A. 1909. "Descriptions and Records of Bees.—XXIII." Ann. & Mag. Nat. Hist. (8) iv. pp. 391–404.

——. 1910. "Some Bees from High Altitudes in the Himalaya Mountains." 'Entomologist,' xliii. pp. 238–42.

——. 1917. "New Social Bees." 'Psyche,' xxiv. pp. 120–8.

——. 1922. "Bees in the Collection of the United States National Museum.—IV." Proc. U.S. Nat. Mus. lx. art. 18, p. 20.

CRESSON, C. T. 1863. "List of the North American Species of *Bombus* and *Apathus*." Proc. Ent. Soc. Philadelphia, ii. pp. 83–115.

DALLA TORRE, C. W. VON. 1890. "Hymenopterologische Notizen." Wien ent. Zeitg. ix. p. 139.

FRIESE, H. 1905. "Neue oder wenig bekannte Hummeln des russischen Reiches (Hymenoptera)." Ann. Mus. Zool. St. Petersburg, ix. (1904), pp. 507–23.

——. 1911. "Neue Varietäten von *Bombus*.—II." Deutsche ent. Zeitschr. pp. 456–7.

——. 1913. "Ueber einige neue Apiden." Arch. f. Naturges. lxxix. A, Heft 12 (1912), pp. 85–89, 4 figs.

——. 1918. "Ueber Hummelformen aus dem Himalaja." Deutsche ent. Zeitschr. pp. 81–86.

——. 1924. "Ueber auffallende Hummelformen (Hym. Apid.)." Deutsche ent. Zeitschr. pp. 437–9.

FRIESE, H., & VON WAGNER, F. 1909. "Zoologische Studien an Hummeln.—I. Die Hummeln der deutsche Fauna." Zool. Jahrb. Syst. xxix. pp. 1–104, 7 pls.

FRISON, T. H. 1927. "A Contribution to our Knowledge of the Relationship of the Bremidæ of America North of Mexico (Hymenoptera)." Trans. Amer. Ent. Soc. liii. pp. 51–78, 2 pls.

GERSTAECKER, A. 1869. "Beiträge zur näheren Kenntniss einiger Bienen-Gattungen." Stett. ent. Zeitg. xxx. pp. 315–67.

HANDLIRSCH, A. 1888. "Die Hummelsammlung des k. k. naturhistorischer Hofmuseums." Ann. k. k. naturhist. Hofmus. iii. pp. 209–50, 1 pl.

——. 1891. "Hummelstudien I–II." Ann. k. k. naturhist. Hofmus. vi. pp. 446–54, 2 figs.

KRÜGER, E. 1917. "Zur Systematik der mitteleuropäischen Hummeln (Hym.)." Ent. Mitt. vi. pp. 55–66.

LEPELETIER DE ST. FARGEAU, A. 1836. 'Histoire naturelle des Insectes Hyménoptères.—I.' Paris.

LINNÉ, C. 1758. 'Systema Naturæ,' 10th ed. Holmiæ.

MORAWITZ, F. 1875. 'Reise in Turkestan von Alexis Fedtschenko. Zoologie 8. Hymenoptera Mellifera. I. Apidæ.' Moscow.

——. 1880. "Ein Beitrag zur Bienen-Fauna Mittel-Asiens." Bull. Acad. Sci. St. Petersburg, xxvi. pp. 337–89.

MORAWITZ, F. 1886. "Insecta in itinere Cl. N. Prshewalskii in Asia centrali novissima lecta. I. Apidæ." Hor. ent. Soc. Ross. xx. pp. 195–229.

PALLAS, P. S. 1771. 'Reise durch verschiedene Provinzen des russischer Reichs.' Erster Theil. St. Petersburg.

POPOV, V. B. 1928. "New Forms of the Genus *Psithyrus*, Lep." Konowia, vi. (1927), pp. 267–74, 2 figs.

RADOSZKOWSKY, O. 1862. "Sur quelques Hyménoptères nouveaux ou peu connus." Bull. Soc. Imp. Nat. Moscou, xxxv. pt. 1, pp. 589–98, 1 pl.

RICHARDS, O. W. 1928 *a*. "*Bombus* and *Volucella* in the Himalayas." Ent. Month. Mag. lxiv. pp. 107–8.

——. 1928 *b*. "On a Collection of Humble-bees (Hymenoptera, Bombidæ) made in Ladakh by Col. R. Meinertzhagen." Ann. & Mag. Nat. Hist. (10) ii. pp. 333–6.

——. 1929 *a*. "The Species of *Psithyrus* allied to *Ps. quadricolor*, Lepeletier (Hymenoptera, Bombidæ)." Trans. Ent. Soc. London, lxxvi. (1928), pp. 345–65, 1 pl.

——. 1929 *b*. "A Revision of the Humble-bees allied to *B. orientalis*, Smith, with the Description of a new Subgenus." Ann. & Mag. Nat. Hist. (10) iii. pp. 388–396, 7 figs.

SKORIKOV, A. S. 1910. "*Bombus mendax*, Gerst., and its Varieties" (Russian). Rev. russe d'Ent. ix. (1909) pp. 328–30.

——. 1912. "Neue Hummelformen, IV. (Hymenoptera, Bombidæ)." Rev. russe d'Ent. xii. pp. 606–10.

——. 1914 *a*. "Les formes nouvelles des bourdons" (Russian). Rev. russe d'Ent. xiv. pp. 119–29.

——. 1914 *b*. "*Subterraneobombus fedtschenkoi* (F. Mor.), un bourdon de Turkestan peu connu" (Russian). Rev. russe d'Ent. xiv. pp. 287–92.

——. 1922. "Les bourdons de la faune paléarctique. Partie I. Biologie générale" (Russian). Bull. Sta. rég. Protect. Plantes, Petrograd, iv. pp. 160, 13 maps.

SMITH, F. 1852. "Descriptions of some Hymenopterous Insects from Northern India." Trans. Ent. Soc. London, (2) ii. pp. 45–48, 1 pl.

——. 1854. 'Catalogue of the Hymenopterous Insects in the Collection of the British Museum.—Part II. Apidæ.' London.

——. 1861. "Descriptions of new Genera and Species of Exotic Hymenoptera." Journ. of Entom. i. pp. 146–55, 1 pl.

——. 1872. "Notes on the Habits of some Hymenopterous Insects from the North-West Provinces of India, by C. Horne, with an Appendix containing Descriptions of some new Species of Apidæ and Vespidæ collected by Mr. Horne, by Frederick Smith." Trans. Zool. Soc. London, vii. pp. 186–90, 4 pls.

——. 1873. "Descriptions of Aculeate Hymenoptera of Japan, collected by Mr. George Lewis at Nagasaki and Hiogo." Trans. Ent. Soc. London, pp. 181–206.

——. 1878. 'The Scientific Results of the Second Yarkand Mission, based upon the Collections and Notes of the late Ferdinand Stoliczka, Ph.D.—Hymenoptera, Pt. II.' Calcutta.

——. 1879. 'Descriptions of new Species of Hymenoptera in the Collection of the British Museum.' London.

VOGT, O. 1909. "Studien über das Artproblem. Ueber das Varieren der Hummeln." Teil I. Sitzungsber. Ges. naturforsch. Freunde, Berlin, pp. 28–84, 1 pl.

——. 1911. Ibid. Teil II, same journal, pp. 31–74.

LXVI.—*Notes on the Fiddler-crab,* Uca leptodactyla, *Rathbun.* By L. HARRISON MATTHEWS, M.A.

[Plate XXV.]

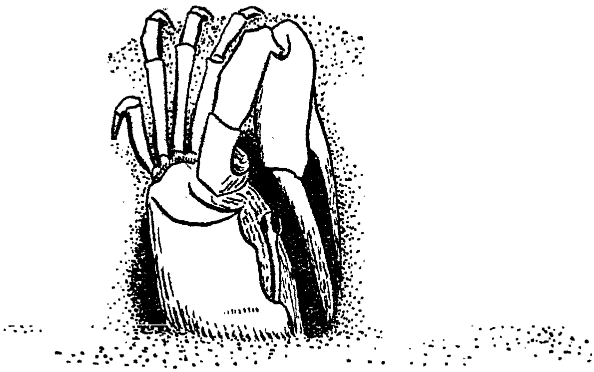
A REEF about 100 yards distant from the land encloses a lagoon and protects the beach from the force of the waves on the shore of Coconut Island, south of Pernambuco, Brazil. The fiddler-crab, *Uca leptodactyla,* Rathbun, lives in large colonies on the part of the sandy beach between tide-marks, each crab living in a burrow 10 to 20 centimetres deep excavated by itself in the sand. Though there is a very large number of crabs in the colonies, each crab lives by itself in its own burrow, and lives at best under conditions of armed neutrality with its neighbours.

Uca leptodactyla is a small fiddler-crab, the carapace of the males measuring about 6 by 10 cm., that of the females being about 1 mm. less each way. The large chela of the male is about 3 cm. long, the propodus being about 2 cm. long. The colour of the carapace of the males is white, and the large chela is lemon-yellow; the females are mottled buff. The males greatly outnumber the females in the colonies.

When the tide exposes the beach the crabs leave their burrows to feed on organic matter which they separate from the sand. But first they have to reconstruct the upper parts of the burrows which have been obliterated by the water. The burrows are so narrow that the crabs can only enter sideways and cannot turn round inside; the males always enter the burrows so that the large chela is uppermost. When digging, the sand excavated is made into pellets about 0·75 cm. in diameter, which are carried out of the burrow by the two anterior legs on the downward (small chela) side. Each pellet is carried to a distance of 7 to 10 cm. from the mouth of the burrow and deposited, and then the crab returns for another load. The pellets are placed together in a semicircular pile on one side of the burrow. When the burrow is finished the crab makes a hood of sand to protect the mouth of it. This is a half-dome of sand with the opening at the side, and is built not of sand excavated from the burrow but from sand scraped up from the surface of the beach near the burrow after the digging is finished. This sand is scraped up by the legs on the large chela side, and is carried by the two anterior legs of that side. On reaching the burrow the crab stands over the entrance and places the sand in position, moulding the outside of the dome with the legs of the large chela side and patting it tight on the inside

with the back of the small chela and the anterior legs of the small chela side. The large chela is held up out of the way while this is being done. When the dome is nearing completion and sand has to be added to it above, the crab partly enters the burrow, and supports itself by the legs of the small chela side which are within the burrow. It then partly turns on to its back and moulds the outside of the dome with the legs of the large chela side (which carry the sand), and compacts the roof by patting it inside with the back of the small chela. When building the top of the dome the large chela is held across the front of the carapace, so as to be out of the

Fig. 1.



Uca leptodactyla, Rathbun.

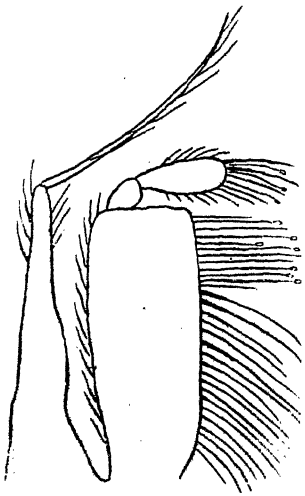
A male constructing the roof of the dome over the mouth of the burrow. The legs of the large chela side mould the outside of the dome, while the small chela compacts it on the inside. The crab is turned nearly on to its back.

way (fig. 1). It is probable that the purpose of the dome is to keep the air in the burrow cool and moist and to prevent the mouth of it from caving in as it dries, for the sun is very hot, though the sand is dried to a depth of 1 to 2 cm. only.

When the dome is built the crab sits at the mouth of the burrow with the large chela held in front, forming a sort of fence, behind which it feeds by picking up small organic particles and grains of sand with the small chela (Pl. XXV.). In feeding the crab picks up one sand-grain at a time with the small chela and places it in the mouth, scours off any adhering organic matter, and rejects the cleaned sand-grain. The endopodites of the second maxillipedes are armed on their median edges with long bristles, some of which have

spoon-shaped ends of which the function is unknown to the writer (fig. 2), and the coxopodites and basipodites of the first maxillipedes bear tufts of bristles forming compact brushes (fig. 3). In life these tufts are placed close together, so that the four (two on each first maxillipede) form one brush directed forwards lying immediately behind the bristles on the median edges of the second maxillipedes. It is between these bristles on the first and second maxillipedes

Fig. 2.



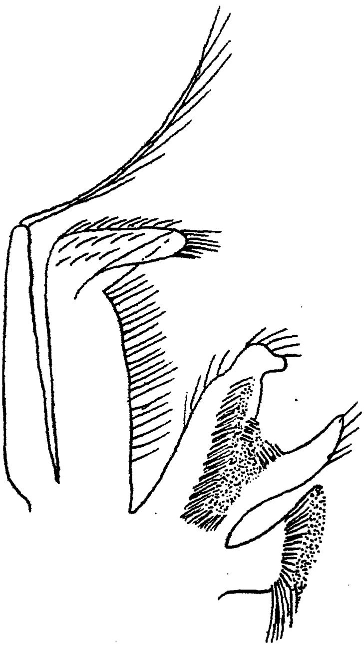
Uca leptodactyla, Rathbun.

Right second maxillipede from the front. The median margin of the endopodite is armed with long bristles, some of those at the distal end having spoon-shaped ends.

that the sand-grains are cleaned of adherent matter. The state of preservation of the specimens examined does not permit of an identification of the stomach contents, but the fact was established that the food is not diatoms adhering to the sand-grains, as, had diatoms been present, their shells would have been easily recognized. No sand was present in the stomachs. Whatever the food is, it evidently consists of minute organisms, perhaps protozoa or unicellular plants and particles of organic débris, adhering to the sand-grains, to clean which such efficient brushes are provided. Each crab feeds chiefly in the area limited by the semicircular pile of pellets on one side and the dome on the other, occasionally making excursions further afield.

Feeding is constantly interrupted while the crab waves the large chela. When a female moves away from her burrow all the males in the neighbourhood energetically wave the large chela. It has been suggested that this is to attract the attention of the female and induce her to enter their burrows. Males further away, who cannot see the female,

Fig. 3.



Uca leptodactyla, Rathbun.

Right first maxillipede, from the front. The surfaces of the coxopodite and basipodite bear tufts of bristles forming brushes. In life these are placed so that the four tufts (two on each side of the mouth) form one brush, with the bristles directed forward immediately behind the second maxillipedes.

notice the males nearer to her waving, and start waving too. The females were not seen to take the slightest notice of the males, nor did the males attempt to approach her (these observations were made early in February). It has been stated that the large chela is used in fighting; on one occasion two males were seen each holding the large chela of the other, but they released each other and bolted to their burrows on being disturbed. Beyond this they were not

seen fighting; when one male approaches the burrow of another the owner waves the large chela, but they do not approach each other closely, and for the most part each crab keeps to its own patch of sand in front of its burrow. The large chela is held in front, forming a guard or fence, whether the crab is feeding or walking about, and it is not used as a stopper to close the mouth of the burrow.

The crabs are very alert; a shadow falling across the colony causes them all to bolt into their burrows, but they soon return to the surface and sit at the burrow-mouths for a few moments, and if not further frightened start feeding again. When walking away from the burrow they usually go large chela first, so that if frightened they can at once bolt into the burrow small chela first. When the tide flows and the water reaches to within 3 to 4 metres of the mouths of the burrows the crabs scrape up from the beach a load of sand with the legs of the large chela side and enter the burrows, plugging them up with the sand about 1 to 2 cm. down. The water obliterates the dome and the mouth of the burrow, which have to be reconstructed at the next ebb.

As far as the writer can ascertain, observations on the habits of this species of fiddler-crab have not been published before, nor have the dome-building and the brushes on the maxillipedes been previously described in *U. leptodactyla* or other species.

EXPLANATION OF PLATE XXV.

Uca leptodactyla, Rathbun. A male at the entrance of the burrow with the large chela held in front as a fence. The dome over the burrow-mouth is to the right, and the semicircular pile of excavated sand pellets is to the left. The small size of the crab may be judged by the coarse appearance of the sand-grains.

LXVII.—*A new Species of* Leptochauliodes, *and a Note on* Chauliodes tenuis, *McLachlan* (*Megaloptera*). By D. E. Kimmins.

Leptochauliodes esben-peterseni, sp. n.

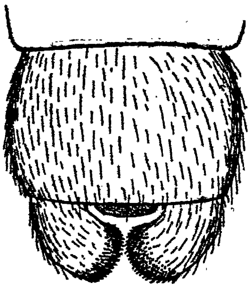
Leptochauliodes tenuis, Esben-Petersen, nec McLachlan, Ann. S. Afr. Mus. xix. p. 157, fig. 7 (1924).

♂. Head brown, oblong, gradually narrowed from behind the eyes to the neck. Antennæ filiform, almost as long as the anterior wings. Prothorax brown, quadrate, nearly

twice as long as broad. Meso- and metathorax yellowish brown. Legs brown, the tarsi darker. Abdomen blackish, superior anal appendages short, stout, incurved, their apices clothed with a mass of minute black bristles. Genital valve quadrate, slightly convex on its upper surface.

Anterior wing elongate, three and a half times as long as broad; membrane hyaline, greyish, marked with brownish along the veins, and a larger brown spot in the anal area. Venation brown, twenty to twenty-three cross-veins in the costal area. Pterostigma feebly marked.

Fig. 1.



Leptochauliodes esben-peterseni, sp. n.
Anal appendages from above.

Posterior wing shorter than anterior, hyaline, greyish, venation brown. Nineteen to twenty-two cross-veins in the costal area, pterostigma brownish.

♀. Larger, antennæ only half as long as anterior wings, which are more distinctly marked with brown. Eyes less prominent.

	♂.	♀.
	mm.	mm.
Length of anterior wing....	26	35
Length of posterior wing ..	23	31
Length of body	18	26

♂, *type*, Cape Colony, Caledon, Hottentot-Hollands Mts., 4000 feet, 1916 (*K. H. Barnard*).

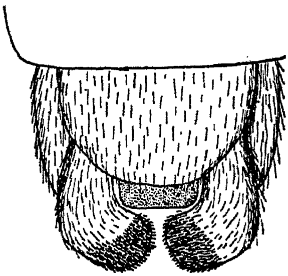
♀, paratype, Cape Colony, Caledon, Hottentot-Hollands Mts., 4000 feet, 1916 (*K. H. Barnard*).

♀, paratype, Wallington, Witte River, 1500 feet, Nov. 1922 (*K. H. Barnard*).

The type and paratypes have been presented to the British Museum by the collector.

The specimens upon which this species is based were sent, as *Leptochauliodes tenuis*, McL., by Mr. K. H. Barnard for comparison with McLachlan's type in the British Museum. Whilst agreeing entirely with the insect described and figured as *L. tenuis* by Dr. P. Esben-Petersen in the 'Annals of the South African Museum,' xix. (1924), they do not agree with the type of *Ch. tenuis*, McL. I have been in correspondence with Dr. Esben-Petersen, and he admits that his conception of *Ch. tenuis*, McL., was incorrect, and, as I had

Fig. 2.



Leptochauliodes esben-peterseni, sp. n.
Anal appendages from beneath.

the material available, he asked me to describe the species for which his genus *Leptochauliodes* was created. The type of this genus will therefore be *Leptochauliodes esben-peterseni*, sp. n. (*Chauliodes tenuis*, Esb.-P., nec McL.). The type of *Chauliodes tenuis*, McL., has, in the fore-wing, the costal area rather broad, and 2A is forked and connected to 1A by a cross-vein. The species should therefore be referred to the genus *Platychauliodes*, Esb.-P. Owing to the inaccessibility of the type of *C. pusillus*, McL., the question of the synonymy of the two species (as suggested by Van der Weele) cannot be settled definitely at present.

LXVIII.—*Additions to the Sponge Fauna of the Gulf of Manaar.* By MAURICE BURTON, M.Sc., Assistant-Keeper, Department of Zoology, British Museum (Nat. Hist.).

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AMONG the many unidentified sponges bequeathed by the late Professor Arthur Dendy to the British Museum was a collection labelled "Third Thurston Collection." The first

and second Thurston collections from the Gulf of Manaar have already formed the subject of two memoirs by Dendy, and it is of interest to record several new species in this third collection.

In the process of identifying these sponges from the Gulf of Manaar, I have made some notes on the genera of the Suberitidæ and Polymastidæ which it seems worth while to include here.

List of the more interesting Species contained in Thurston's Third Collection from the Gulf of Manaar.

Cinachyra hirsuta (Dendy).

Tetilla hirsuta, Dendy, 1889 β, p. 75; id. 1905, p. 89; id. 1916, p. 104.

It is difficult to understand why Dendy, after having stressed the similarity between the canal-systems of this species and *Cinachyra barbata* in his original description of the species, should have persisted in referring it to *Tetilla*. It is beyond question a *Cinachyra*.

The colour, in life, is recorded as "green and yellow."

Chalina similis (Ridley & Dendy).

Petrosia similis, Ridley & Dendy, 1886, p. 327; id. 1887, p. 9, pl. ii. fig. 10, pl. iii. figs. 3–4; Dendy, 1905, p. 145.

The present specimen agrees closely with those described by Dendy (*l. c.*). The colour in life was dark blue.

This species must be removed from *Petrosia* owing to the absence of a tangential dermal skeleton and the presence of oxea only, except where strongyla are occasionally produced by modification of the oxea. It has practically nothing in common with the genotype of *Petrosia* and is, in fact, nothing more than a "Reniera" with unusually dense skeleton.

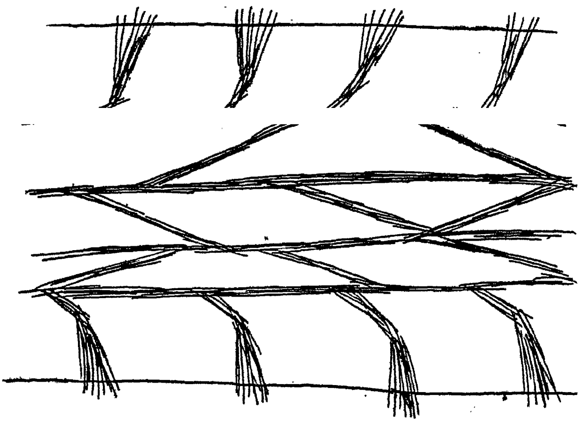
Chalina tenuiramosa, sp. n.

Holotype.—B.M. no. 25.11.1.1355.

Diagnosis.—Sponge a mass of long slender cylindrical branches, varying from 1–4 mm. in thickness; surface even, minutely hispid; vents small, distributed in an irregular linear series; colour in life olive-green, in spirit light brown. Skeleton a fairly regular unispicular reticulation, with quadrangular or triangular mesh; spongin only at nodes of reticulation; no special multispicular fibres or special dermal skeleton; spicules oxea, smooth, slightly curved, ·15 by ·006 mm.

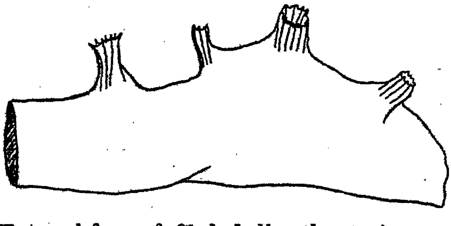
Remarks:—The species is in external form not unlike *Halichondria tenuiramosa*, Dendy, but is readily distinguishable from that species by the size of its spicules and the structure of its skeleton. Moreover, *H. tenuiramosa* is a *Chalina* (see fig. 1) and the species must revert to its original specific name, viz.:—*Chalina reticulata* (Baer).

Fig. 1.



Longitudinal section through a branch of *Chalina reticulata* (Baer), (=*Halichondria tenuiramosa*, Dendy), showing the arrangement of the skeleton. (Semi-diagramatic.)

Fig. 2.



External form of *Cladochalina thurstoni*, sp. n. (Slightly larger than natural size.)

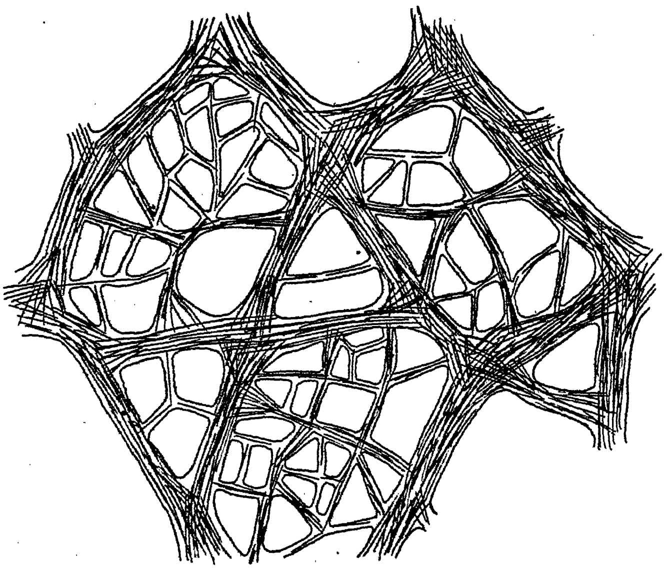
Cladochalina thurstoni, sp. n. (Figs. 2, 3.)

Holotype.—B.M. no. 25.11.1.1362.

Diagnosis.—Sponge massive (?); surface smooth, even; vents situated at summits of tubular processes, in linear series; margins of vents serrated; colour in life white, in

spirit pale brown; main skeleton a stout multispicular reticulation of spiculo-fibre enclosing a quadrate mesh, becoming irregular in places, with primary fibres ·175 mm. thick; dermal skeleton an irregular network of multispicular fibre enclosing irregularly triangular, quadrate or polygonal primary meshes subdivided into secondary or even tertiary

Fig. 3.



Dermal skeleton of *Cladochalina thurstoni*, sp. n. × 60.

meshes (fig. 3); tertiary fibres, when present, usually unispicular; spicules oxea, straight or curved, ·07 by ·003 mm.

Remarks.—The single specimen consists of a mere fragment bearing several vents (fig. 2), so that it is impossible to state the shape of the complete sponge. The species is characterised by the smooth even surface and the shape of the vents, in addition to the peculiar structure of the dermal skeleton.

Clathria mœandrina, Ridley.

The species has been recorded but once before, from the Amirantes Islands.

Acanthoxifer ceylonensis, Dendy.

In life the colour of this specimen was orange.

Sclerochalina spinilamella (Dendy).

Pachychalina spinilamella, Dendy, 1889 β, p. 80.

The genus *Sclerochalina* is characterised by a special tangential dermal skeleton composed of a primary mesh subdivided into secondary and tertiary meshes, as in *Cladochalina*. It differs from the latter genus, however, in that the primary fibres of the main skeleton are continued through the nodes of the dermal skeleton as short aculeate processes of spiculo-fibre giving the sponge a characteristic, minutely-conulose appearance. In this respect, the present species clearly corresponds with the typical form of *Sclerochalina* and is, in fact, almost specifically indistinguishable from the genotype, *S. crassa*, Keller.

Laxosuberites proteus, Hentschel.

Laxosuberites proteus, Hentschel, 1909, p. 389, pl. xxii. figs. 1–3, text-figs. 20–23.

There are two specimens which appear to agree closely with those described by Hentschel from S.W. Australia. The first consists of two kidney-shaped lobes, with slighly uneven surface suggesting an incipient papillation. The second consists of a long finger-shaped lobe, 4 cm. long and ·5 cm. in diameter, with perfectly smooth surface.

Laxosuberites conulosus, sp. n.

Holotype.—B.M. no. 25.11.1.1360.

Diagnosis.—Sponge massive, pyramidal; surface covered with conuli of varying size, of which largest is 5 mm. high and 2 mm. in diameter at base; surface minutely hispid in patches; texture tough but compressible; vents not apparent; colour in spirit pale brown, in life chrome-yellow; skeleton composed of irregular bundles of spicules, with apices directed towards surface, becoming very feeble just below ectosome; spicules tylostyli, and modifications thereof, ·56 by ·007–·014 mm.

The species differs from *L. proteus* in external form, and in the manner in which the skeleton thins out near the surface. There is, on the other hand, considerable resemblance between it and *L. rugosus*, from Europe, both in external form and in the structure of the skeleton, while the spicules are almost identical in the two species (see Topsent, 1900, pl. v. figs. 1–4). Provisionally, I regard the geographical separation, together with the small differences in external form, as a good reason for not identifying the present specimen with the European species.

A Revision of the Genera of the *Polymastidæ* and *Suberitidæ*.

Family **Polymastidæ**.

Diagnosis.—Corticate, non-boring Hadromerina, with skeleton composed typically of large and small tylostyli, which may be replaced by styli, the larger tylostyli arranged in well-defined radial bundles, and perhaps in one or more tangential cortical layers, the smaller forming a dermal palisade; spirasters, pseudasters, and discasters never present.

Genus Polymastia, Bowerbank.

Polymastia, Bowerbank, 1864, p. 177.
Spinularia, Gray, 1867, p. 524.
Penicillaria, id. *l. c.* p. 527.
Rinalda, Schmidt, 1870, p. 51.
? *Clathroscula*, Merejkowsky, 1879, p. 43.
Weberella, Vosmaer, 1855, p. 16.
Rhaphidorus, Topsent, 1898 γ, p. 244.

Genotype.—*Spongia mammillaris*, Müller.

Diagnosis.—Polymastidæ of massive sessile form, usually papillate; skeleton composed of tylostyli, occasionally replaced by styli, arranged in stout radial bundles, with one or more layers of tangentially-placed subdermal tylostyli, and a dermal palisade of brushes of smaller tylostyli placed at right angles to surface.

The genus *Penicillaria* was proposed by Gray for *Halichondria mammillaris*, Johnston, so that it is a synonym of *Polymastia*. Both *Spinularia* and *Rhaphidorus* differ from the typical form of *Polymastia* only in the presence of trichodragmata, and, since it is becoming abundantly clear that this form of spicule has no taxonomic importance, the two genera must also be considered as synonyms of *Polymastia*. *Rinalda* differs in no important respect from the latter genus, and *Weberella* differs only in certain histological details, which can hardly be of generic importance. *Clathroscula*, a *nomen nudum*, was evidently intended for a type of sponge indistinguishable from the typical *Polymastia*.

Genus Quasillina, Norman.

Quasillina, Norman, 1869 α, p. 329.
Bursalina, Schmidt, 1875, p. 116.

Genotype.—*Polymastia brevis*, Bowerbank.

Diagnosis.—Polymastidæ of spherical form, stipitate, and with a single apical vent; skeleton of choanosome feebly developed, composed of sparsely scattered bundles of large

styli; cortical skeleton well developed, forming a tangential layer of large styli with dermal brushes of smaller styli.

Genus RADIELLA, Schmidt.

Radiella, Schmidt, 1870, p. 48.
Trichostemma, Sars, 1872, p. 62.

Genotype.—*Radiella sol*, Schmidt.

Diagnosis.—Polymastidæ of discoid form, papillate, with marginal fringe of spicules; choanosomal skeleton composed of stellate groups of small tylostyli; cortical skeleton of lower surface composed of a tangential layer of large tylostyli which merge insensibly into marginal fringe; cortical skeleton of upper surface composed of large radially-disposed tylostyli ending in a palisade of small tylostyli at surface.

Genus PROTELEIA, Ridley & Dendy.

Proteleia, Ridley & Dendy, 1886, p. 152.

Genotype.—*P. sollasi*, Ridley & Dendy.

Diagnosis.—Differs from *Polymastia* in possession of a dermal layer of small grapnel spicules projecting beyond ectosome.

Genus RIDLEIA, Dendy.

Ridleia, Dendy, 1888, p. 515.

Genotype.—*R. oviformis*, Dendy.

Diagnosis.—Sponge oviform, stipitate, with single apical vent; choanosome almost entirely aspiculous; cortical skeleton composed of a tangential layer of long tylostyli, situated at inner margin of cortex, a layer of obliquely-placed intercrossing tylostyli occupying centre of cortex, and a dermal layer of brushes of small tylostyli.

The genus *Ridleia* bears a strong resemblance to *Quasillina*, but differs in the aspiculous nature of the choanosome, the structure of the cortical skeleton, and the possession of tylostyli instead of styli.

Genus TYLEXOCLADUS, Topsent.

Tylexocladus, Topsent, 1898 γ, p. 242.

Genotype.—*T. joubini*, Topsent.

Diagnosis.—Differs from *Polymastia* in possession of cladotylostyli projecting at surface and centrotylote oxea associated with choanosomal skeleton.

Genus Sphærotylus, Topsent.

Sphærotylus, Topsent, 1898 γ, p. 244.

Genotype.—*Polymastia capitata*, Vosmaer.

Diagnosis.—Differs from *Polymastia* only in possession of of a dermal layer of sphærotylostyli.

Genus Atergia, Stephens.

Atergia, Stephens, 1915, p. 32.

Genotype.—*A. corticata*, Stephens.

Diagnosis.—Polymastidæ of rounded massive form, sessile, papillate; skeleton composed of well-defined bundles of large tylostyli running radially to and projecting beyond surface, a dermal palisade of small tylostyli, and bundles of small oxea scattered throughout choanosome between radial bundles of tylostyli.

Genus Trachyteleia, Topsent.

Trachyteleia, Topsent, 1929, p. 152.

Genotype.—*T. stephensi*, Topsent.

Diagnosis.—Differs from *Polymastia* in possession of a layer of large tylostyli with distal ends spinous and projecting through dermal palisade of small tylostyli.

Genus Vosmaeria, Levinsen.

Vosmaeria, Levinson, 1885 *, p. 24.

Genotype.—*V. crustacea*, Levinsen.

Diagnosis.—Polymastidæ of massive form, bearing fistulous processes; choanosomal skeleton of radial bundles of long tylostyli; dermal skeleton a dense tangential layer of pseudoxea.

Family Suberitidæ.

Diagnosis.—Corticate, non-boring Hadromerina, with skeleton composed typically of large and small tylostyli, which may be replaced by styli; larger spicules arranged in an irregular reticulation or in diffuse radial bundles, smaller forming a dermal palisade or a loose aggregation of brushes placed at right angles to surface; occasionally only one category of tylostyli present, and dermal palisade composed of spicules identical with those of choanosome; in encrusting forms with one spicule-form only, dermal palisade usually absent; spirasters, pseudasters, and discasters never present.

* Kongl. Svenska Vetens.-Akad. Handl. xxi. 6, 1885, p. 24, pl. ii.

It may be reasonably questioned whether the families Polymastidæ and Suberitidæ should be separated in practice. Certain it is that the task of framing adequate diagnoses to meet such a separation is almost impossible.

Genus SUBERITES, Nardo.

Suberites, Nardo, 1833, p. 523.
Lithumena, Lieberkühn, 1859, p. 520.
Ficulina, Gray, 1867, p. 523.
Suberella, Thiele, 1905, p. 416.

Genotype.—*Alcyonium domuncula*, Olivi.

Diagnosis.—Suberitidæ of massive form; skeleton consisting of an irregularly radial main skeleton of large tylostyli, and a dermal palisade of small tylostyli set at right angles to surface.

Ficulina is here included as a synonym of *Suberites*, because the only difference between them is said to be the presence of microstrongyla in the former and their absence in the latter. Since the distribution of these microscleres is variable, and since it is not improbable that *Ficulina ficus*, the only species of the genus, may eventually prove to be synonymous with one of the better known of the European species of *Suberites*, there remains no justification for the retention of the genus *Ficulina*.

Suberella, a subgenus of *Suberites*, was erected by Thiele for *Suberites heros*, Schmidt. Topsent (1900, p. 226) has shown, however, that this species is a synonym of *S. domuncula*, the genotype of *Suberites*.

Genus TERPIOS, Duchassaing & Michelotti.

Terpios, Duchassaing & Michelotti, 1864, p. 97.

Genotype.—*T. fugax*, Duchassaing & Michelotti.

Diagnosis.—Suberitidæ of encrusting habit; skeleton composed of tylostyli with trilobed heads arranged in no apparent order.

Genus CAULOSPONGIA, Kent.

Caulospongia, Kent, 1871 *a*, p. 616.
Plectodendron, Lendenfeld, 1888, p. 66

Genolectotype.—*C. plicata*, Kent.

Diagnosis.—Suberitidæ of erect growth, stipitate, with sponge-body composed of central axis bearing spirally-arranged laminæ; skeleton of body composed of a reticulation of spongin fibres cored by tylostyli with bilobed heads

and ending at surface in loose dermal brushes of similar spicules; skeleton of stalk essentially same as in body, but without dermal brushes.

I have chosen *Caulospongia plicata* as genolectotype, although it was the second species described by Kent in his original account of the genus, because it is the only species of which I have been able to obtain information, apart from the bare account given by Kent.

Hallmann (1914, p. 348) has already alluded to the synonymy of *Plectodendron* with *Caulospongia.*

Genus Tentorium, Vosmaer.

Thecophora (preoccupied), Schmidt, 1870, p. 50.

Genotype.—*Thecophora semisuberites*, Schmidt.

Diagnosis.—Suberitidæ of symmetrical columnar form, with apical vent; main skeleton composed of bundles of long tylostyli, passing vertically to end in a dermal palisade of small tylostyli in cortex of upper surface of sponge; cortical skeleton of lateral walls composed of large tylostyli lying parallel to surface.

Genus Axosuberites, Topsent.

Axosuberites, Topsent, 1893 β, p. 179.

Genotype.—*A. fauroti*, Topsent.

Diagnosis.—Suberitidæ with central axis of tylostyli bound together by spongin, and radial bundles of similar spicules running from central axis to surface to end in brushes of slightly smaller tylostyli.

Genus Laxosuberites, Topsent.

Laxosuberites, Topsent, 1896, p. 126.

Genotype.—*Suberites rugosus*, Schmidt.

Diagnosis.—Suberitidæ of massive form, with skeleton of tylostyli of one size arranged in radial bundles or in a confused reticulation in choanosome and forming surface brushes.

Genus Pseudosuberites, Topsent.

Pseudosuberites, Topsent, 1896, p. 127.
Suberanthus, Lendenfeld, 1897, p. 144.

Genotype.—*Hymeniacidon hyalinus*, Ridley & Dendy.

Diagnosis.—Suberitidæ of massive irregular form; skeleton composed of tylostyli of one size only, arranged in an irregular reticulation in choanosome and as a tangential layer in ectosome.

Genus PROTOSUBERITES, Svarczevsky.

Protosuberites, Svarczevsky, 1905, p. 36.

Genotype.—*P. prototypus*, Svarczevsky.

Diagnosis.—Suberitidæ of encrusting habit; skeleton composed of basal layer of vertically-placed large tylostyli, echinating substratum, and ectosomal layer of small tylostyli set at varying angles to surface.

Genus LAXOSUBERELLA, nom. nov.

Suberella, Burton, 1929, p. 446; nec *Suberella*, Thiele.

Genotype.—*Suberella topsenti*, Burton.

Diagnosis.—Suberitidæ of massive form, with specialised pore-areas; skeleton composed of tylostyli of one size, forming an irregular reticulation in choanosome and a loose palisade in cortex.

The genus differs from *Laxosuberites* mainly in the possession of specialised pore-areas.

Genus PROSUBERITES, Topsent.

Prosuberites, Topsent, 1894 ε, p. xlii.

Genotype.—*P. longispina*, Topsent.

Diagnosis.—Suberitidæ of encrusting form; skeleton composed of tylostyli of one size placed vertically to substratum.

Genus TERPIOSELLA, gen. nov.

Genotype.—*Ophlitaspongia fucoides*, Bowerbank *.

Diagnosis.—Suberitidæ growing associated with algæ; skeleton composed of tylostyli of variable size echinating thallus of alga.

Terpios symbiotica, Hentschel (1909), also belongs to this genus.

LIST OF LITERATURE REFERRED TO.

1864. BOWERBANK, J. S. 'A Monograph of the British Spongiadæ. London, 8vo, vol. i.

1929. BURTON, M. "Porifera.—Part II. Antarctic Sponges." Brit. Ant. ('Terra Nova') Exped. 1910, London, 4to, vi. no. 4, pp. 393–458.

1888. DENDY, A. "Studies on the Comparative Anatomy of Sponges. —I. On the Genera *Ridleia*, n. gen., and *Quasillina*, Norman." Quart. J. Microsc. Soc. xxviii. pp. 513–529.

1889 β. ——. "Report on a Second Collection of Sponges from the Gulf of Manaar." Ann. & Mag. Nat. Hist. iii. pp. 73–99.

1905. ——. "Report on the Sponges collected by Professor Herdman at Ceylon." Rep. Pearl Oyster Fish., Suppl. xviii. pp. 57–246.

* Proc. Zool. Soc. London, 1876, p. 771, pl. lxxx.

1864. DUCHASSAING, F. DE, & MICHELOTTI, G. "Spongiaires de la Mer caraïbe." Natuurk. verh. Mij. Haarlem, xxi. pp. 1–124.

1867. GRAY, J. E. "Notes on the Arrangement of Sponges etc." Proc. Zool. Soc. London, pp. 492–558.

1914. HALLMANN, E. F. "A Revision of the Monaxonid Species etc." Proc. Linn. Soc. N.S.W. xxxix. pp. 227–376.

1909. HENTSCHEL, E. "Tetraxonida, Th. I." Fauna S.W.-Australiens, ii. 21, Jena, pp. 347–402.

1871 α. KENT, W. S. "On a new Genus of Sponges from North Australia." Proc. Zool. Soc. London, pp. 615–616.

1888. LENDENFELD, R. VON. 'Descriptive Catalogue of the Sponges in the Australian Museum, Sydney.' London, 8vo, 260 pp.

1896. ——. "Die *Clavulina* der Adria." Nova Acta Acad. Leop. Carol. lxix. pp. 1–251.

1859. LIEBERKÜHN, N. "Neue Beiträge zur Anatomie der Spongien." Arch. Anat. Phys. pp. 515–529.

1879. MEREJKOWSKY, C. "Études sur les éponges de la Mer Blanche." Mém. Acad. St. Pétersbourg, xxvi. pp. 1–51.

1833. NARDO, G. D. "Auszug aus einem neuen System der Spongiarien." 'Isis' (Oken), Coll. 519–523.

1869 α. NORMAN, A. M. "Final Dredging Report.—Part II." Rep. 38th Meeting Brit. Assoc. pp. 247–336.

1886. RIDLEY, S. O., & DENDY, A. "Preliminary Report on the Monaxonida collected by H.M.S. 'Challenger.'" Ann. & Mag. Nat. Hist. xviii. pp. 325–351.

1887. ——. "Monaxonida." Rep. Scient. Res. Voyage H.M.S. 'Challenger,' London, Zoology, xx. 275 pp.

1872. SARS, G. O. 'On some Remarkable Forms of Animal Life etc.' Christiania, 4to, 82 pp.

1870. SCHMIDT, O. 'Grundzüge einer Spongien-Fauna des atlantischen Gebietes.' Leipzig, Fol., 88 pp.

1915. STEPHENS, J. "Sponges of the Coast of Ireland.—I. The Triaxonida and Part of the Tetraxonida." Dublin, Fish. Ireland Sci. Invest. iv., 43 pp.

1905. SWARTSCHEWSKY, B. "Beitrag zur Kenntniss der Schwamm-Fauna des Schwarzen Meeres." Mém. Soc. Nat. Kiew, xx. pp. 1–59.

1905. THIELE, J. "Die Kiesel- und Hornschwämme der Sammlung Plate." Zool. Jahrb. Jena, Suppl. vi. pp. 407–496.

1893 β. TOPSENT, E. "Note sur quelques éponges du Golfe de Tadjoura." Bull. Soc. Zool. Fr. xviii. pp. 177–182.

1894 ε. ——. "Nouvelle série de diagnoses d'éponges de Roscoff et Banyuls." Arch. Zool. Expér., i. pp. xxxiii.–xliii.

1896. ——. "Matériaux pour servir à l'étude de la faune des Spongiaires de France." Mém. Soc. Zool. Fr. ix. pp. 113–133.

1898 γ. ——. "Eponges nouvelles des Açores." Mém. Soc. Zool. Fr. xi. pp. 225–255.

1900. "Etude monographique des Spongiaires de France.—III. Monaxonida." Arch. Zool. Expér. viii. pp. 1–331.

1929. ——. "Spongiaires de l'Atlantique et de la Méditerranée etc." Rés. Camp. Sci. Albert Monaco, lxxiv. 376 pp.

1885. VOSMAER, G. C. J. "The Sponges of the Willem Barents Expedition etc." Bijdr. Dierk. xii. pp. 1–47.

(References prior to 1913 are quoted from Vosmaer's Bibliography).

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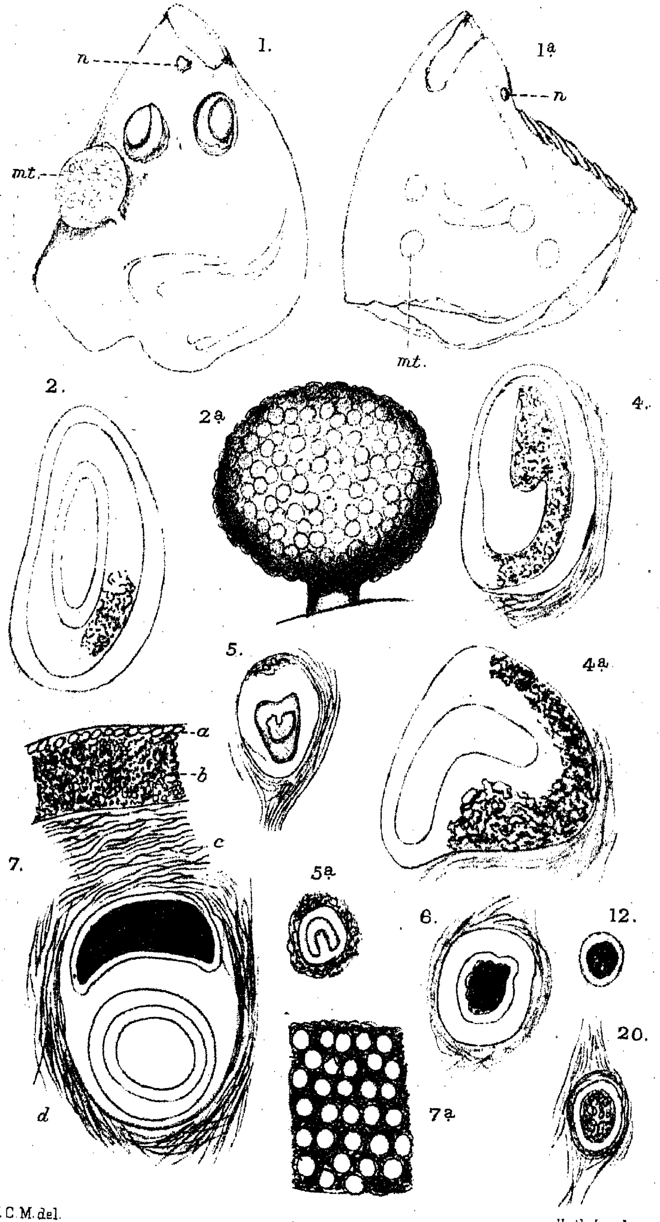

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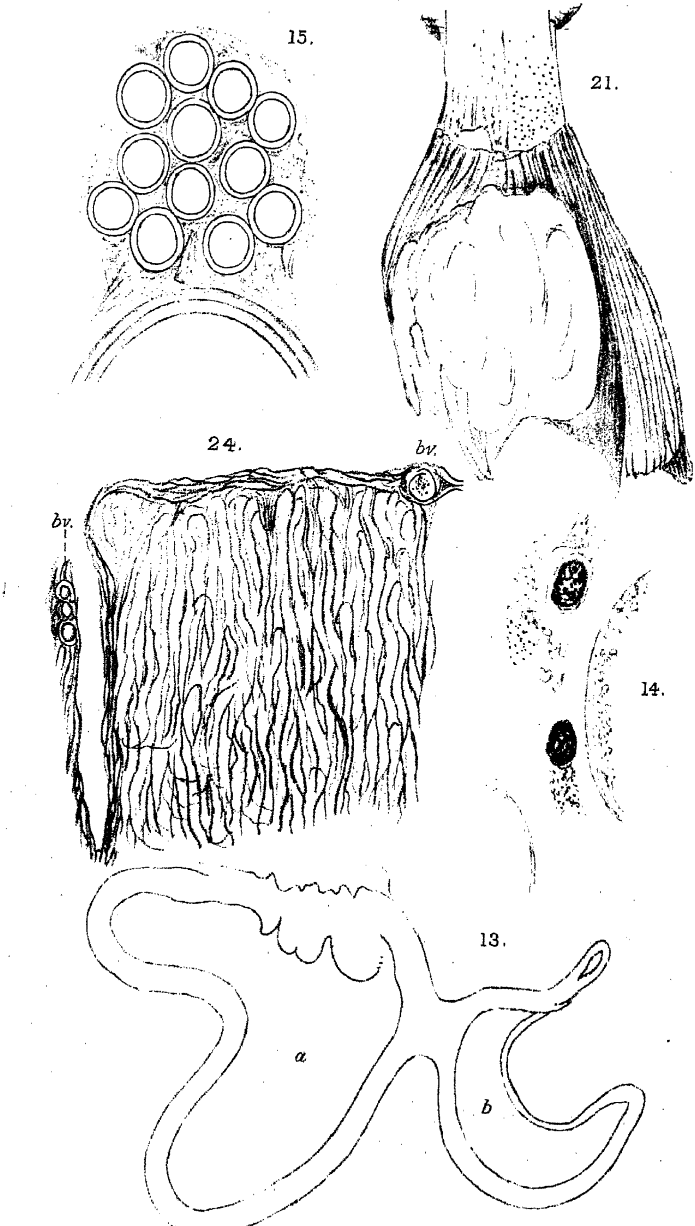

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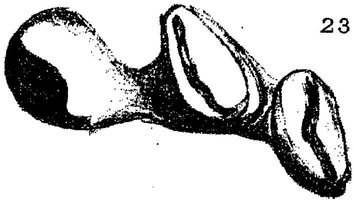

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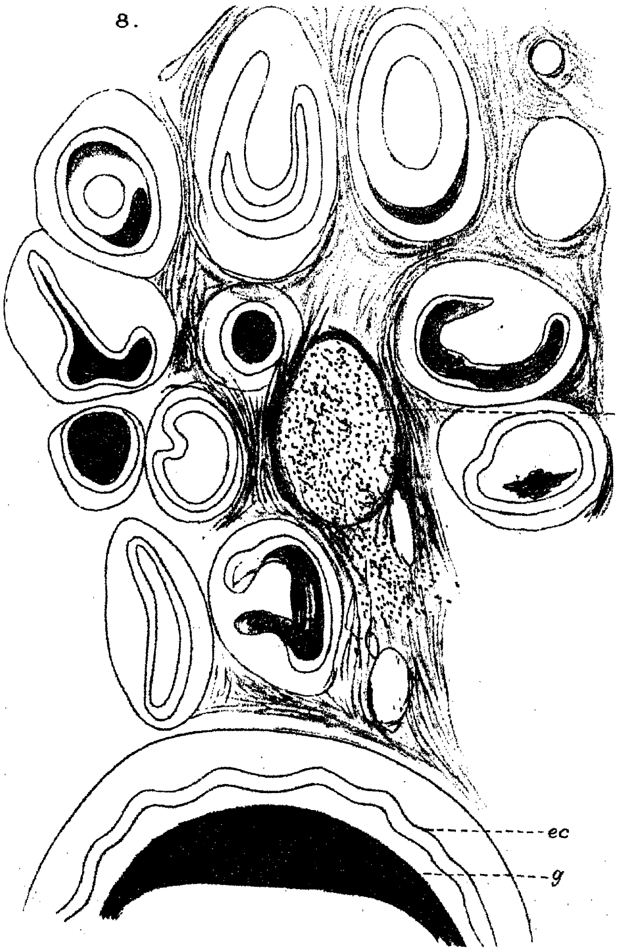

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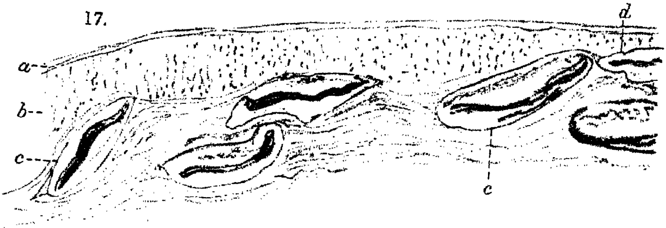

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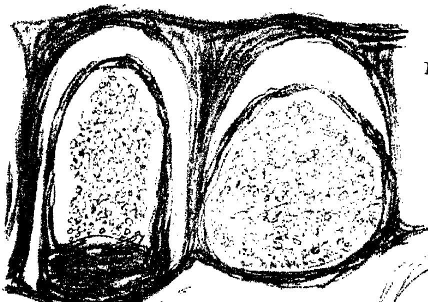

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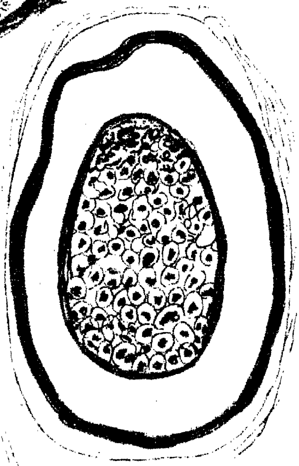

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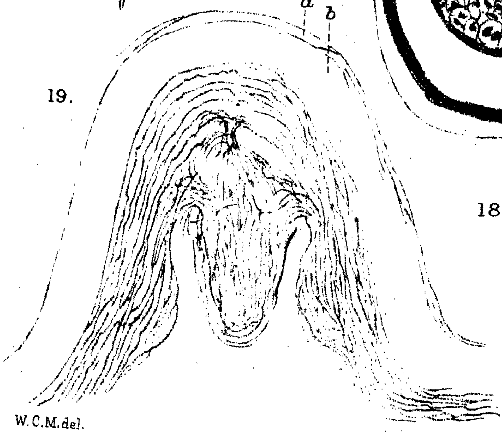

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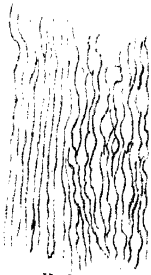

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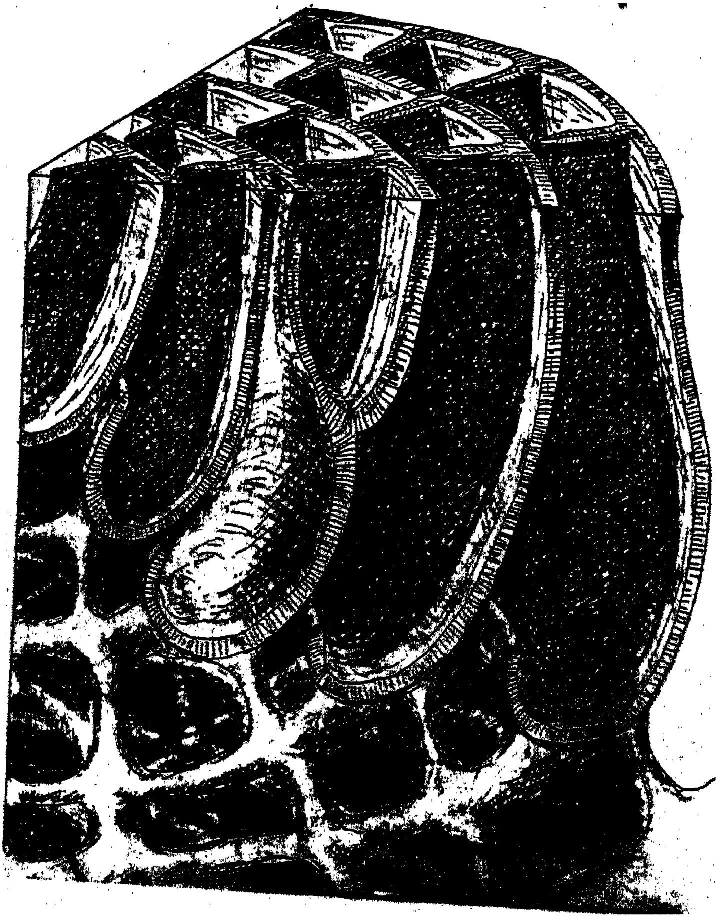
STRUCTURE OF TUMOUR IN TAIL OF PLAICE.



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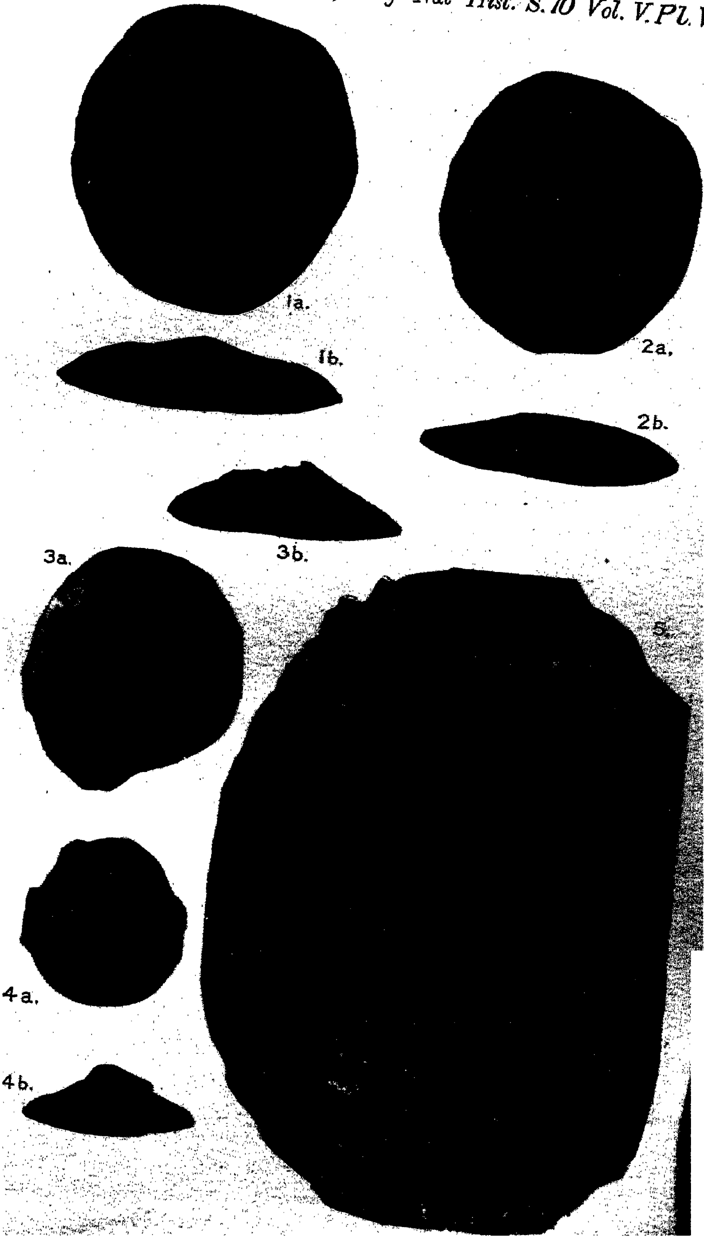

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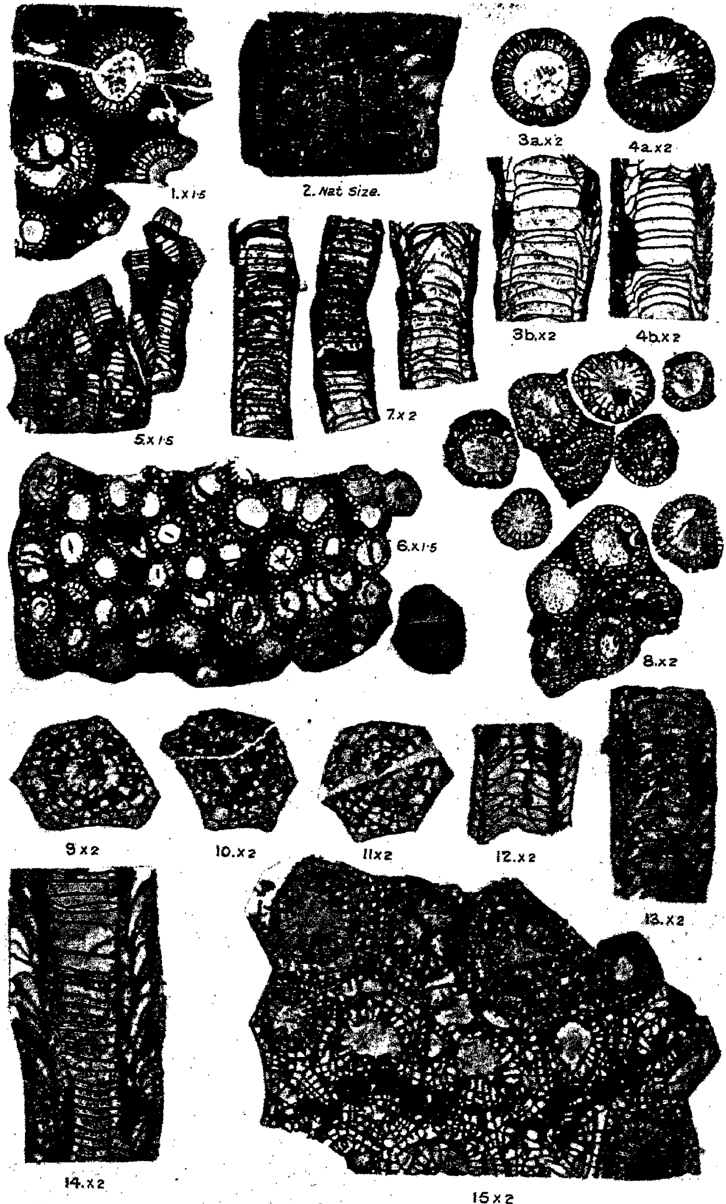

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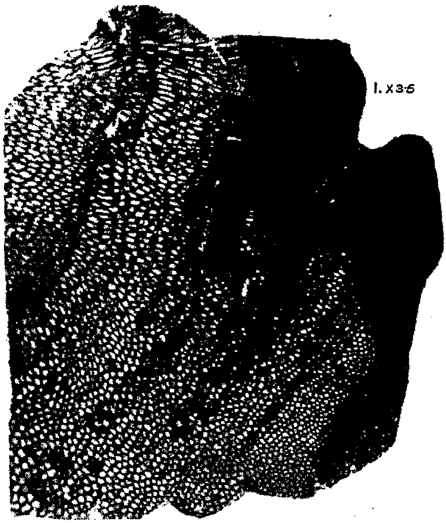

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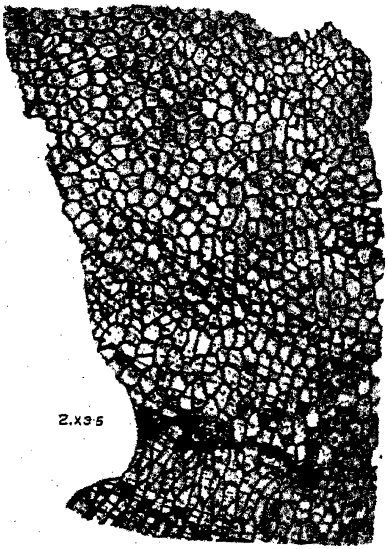

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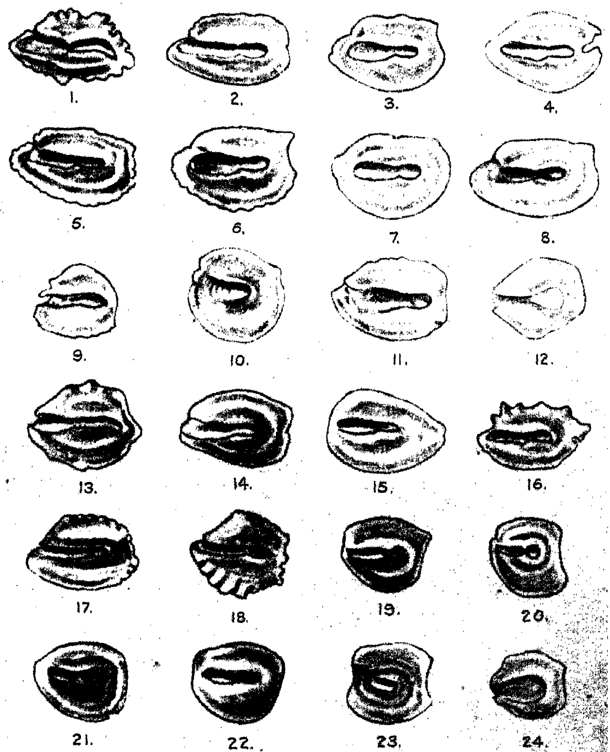

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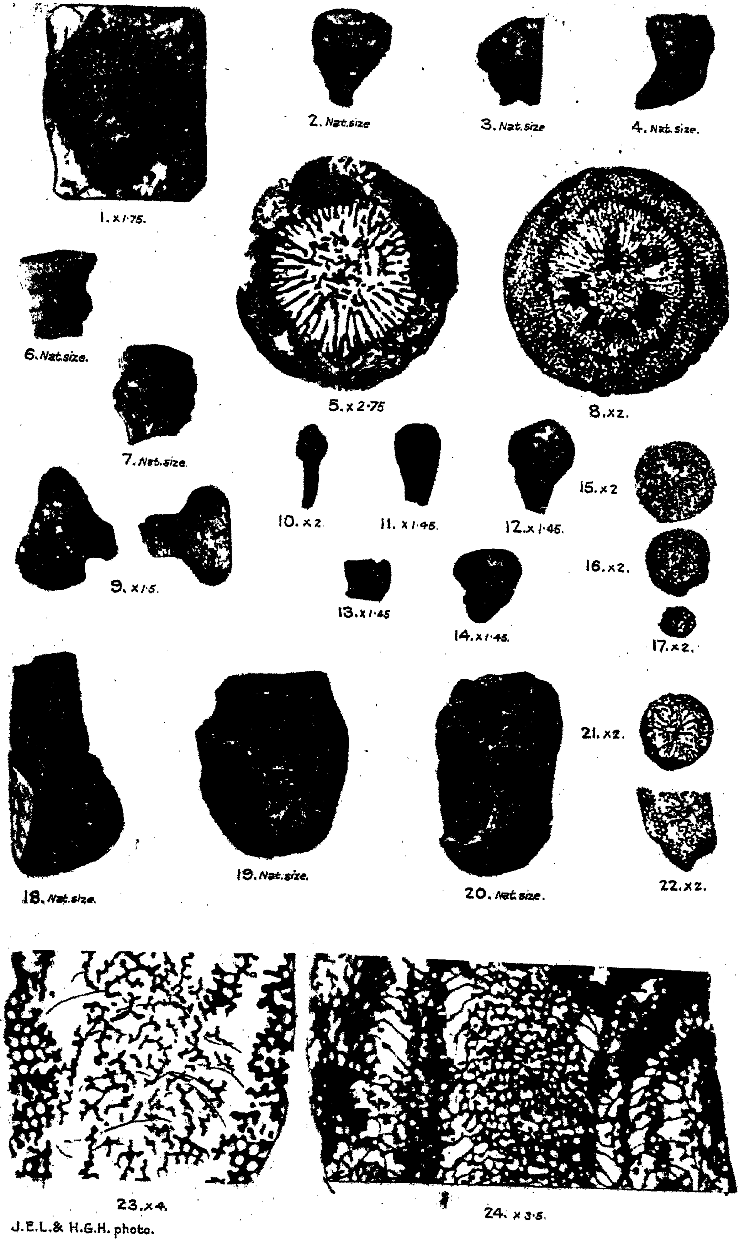

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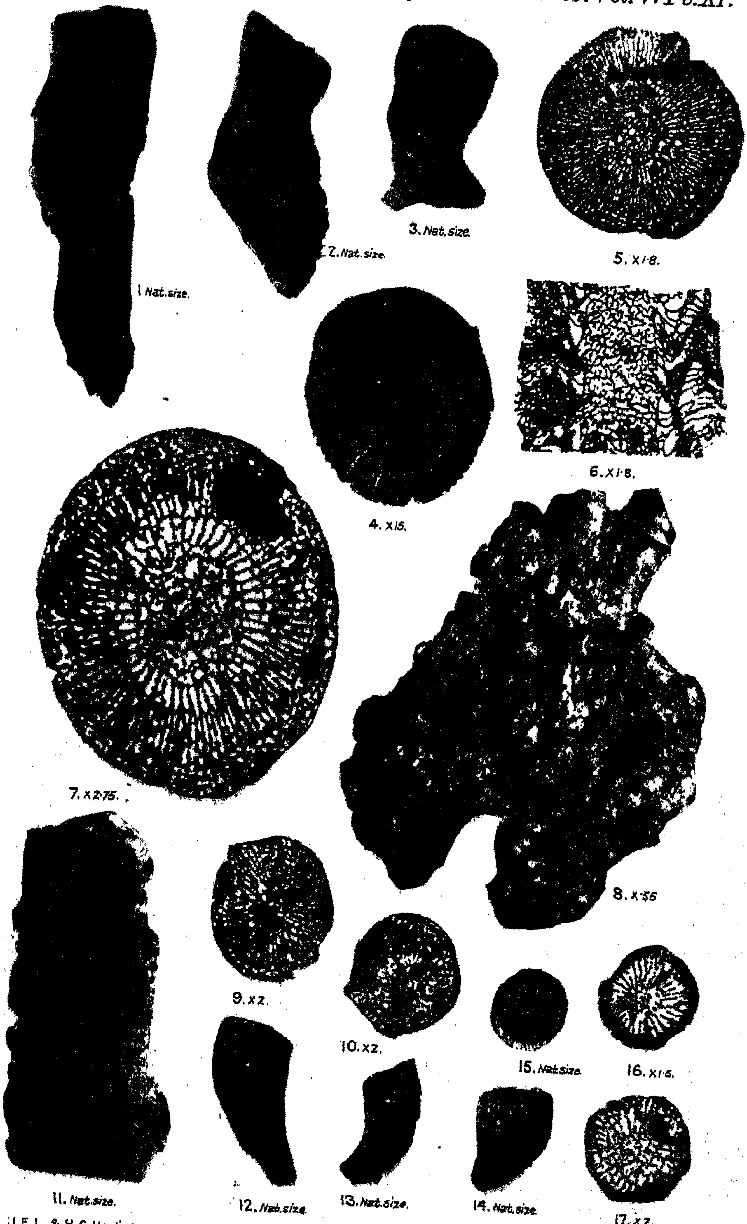

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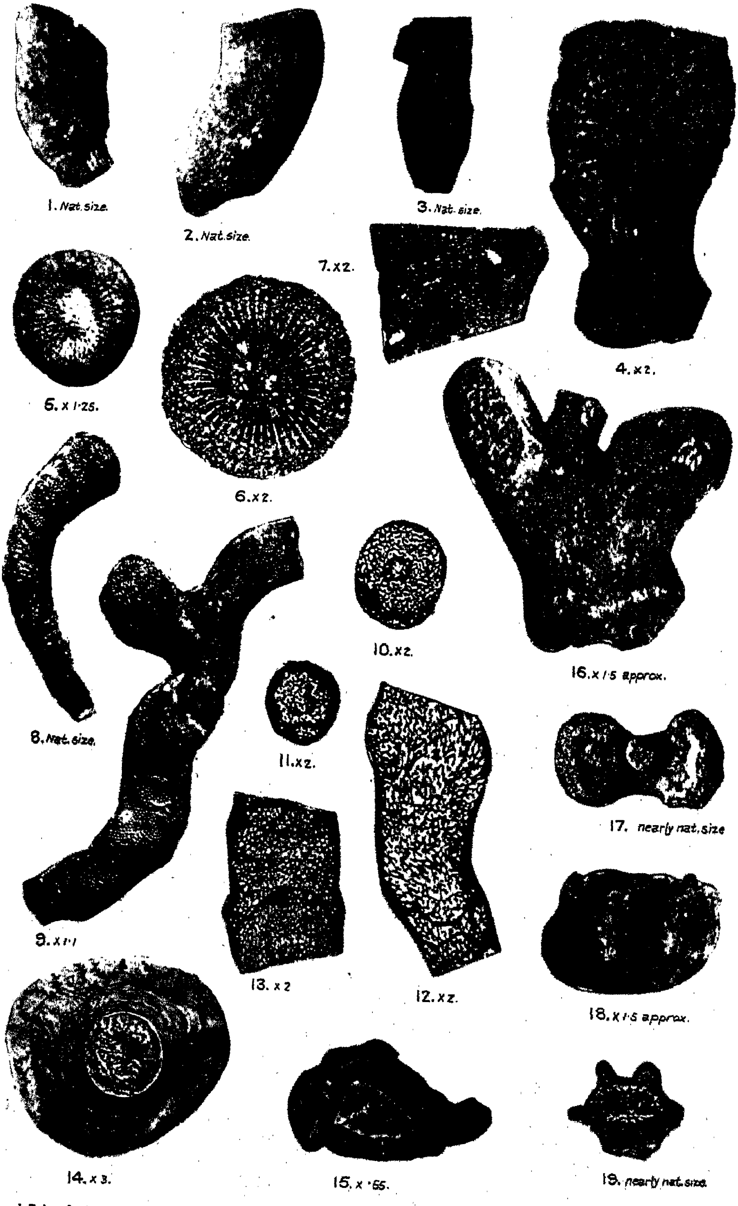
CALOSTYLIS DENTICULATA (Kjerulf) and C. TOMESI sp. n.



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CALOSTYLIS SPONGIOSA Foerste, HELMINTHIDIUM MIRUM Lindström,
LOBOPSAMMIA CARIOSA (Goldf.) ENDOPACHYS MACLURII (Lea).

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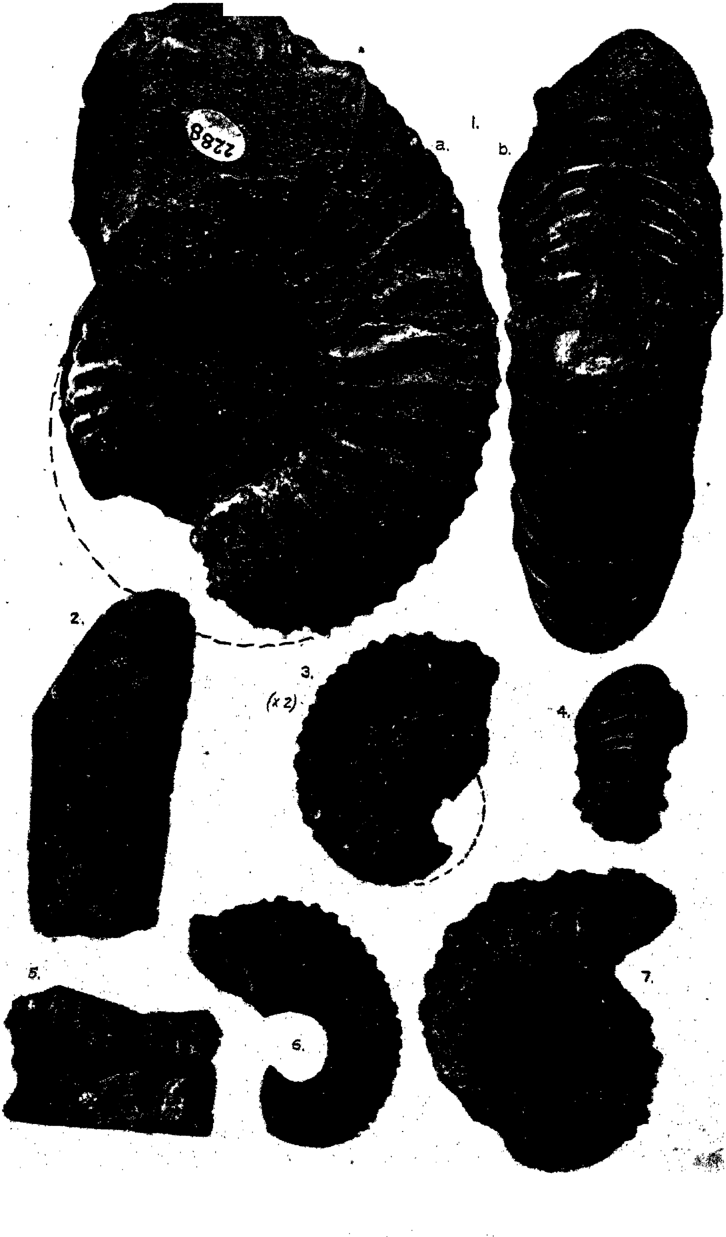

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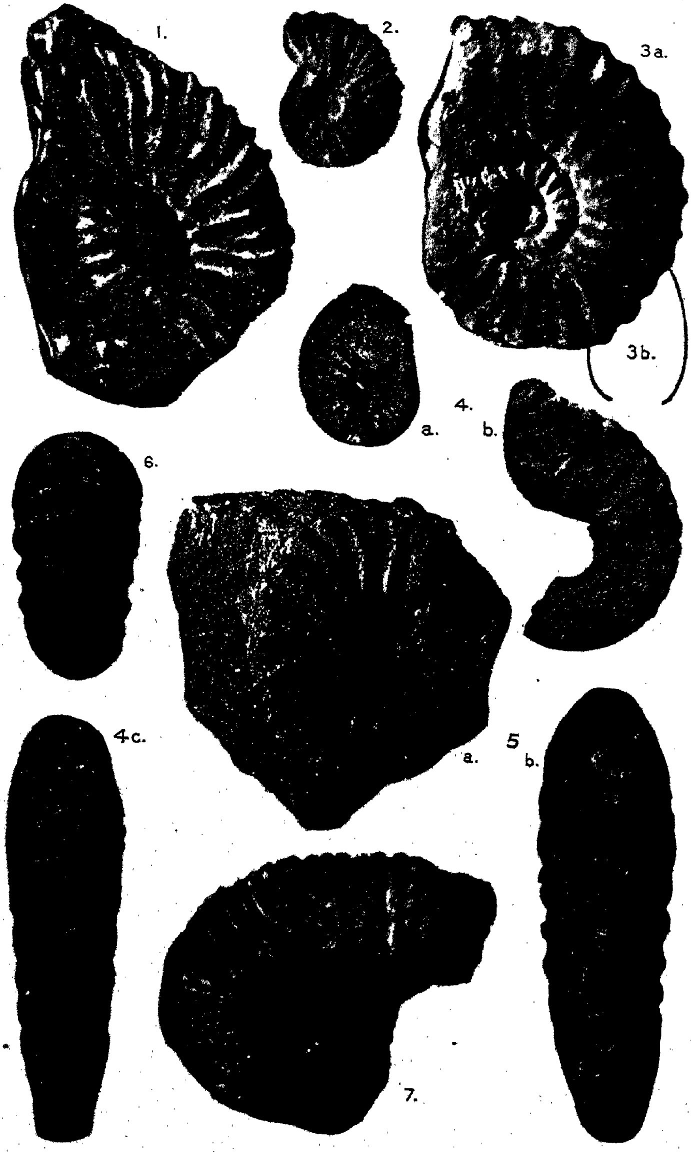

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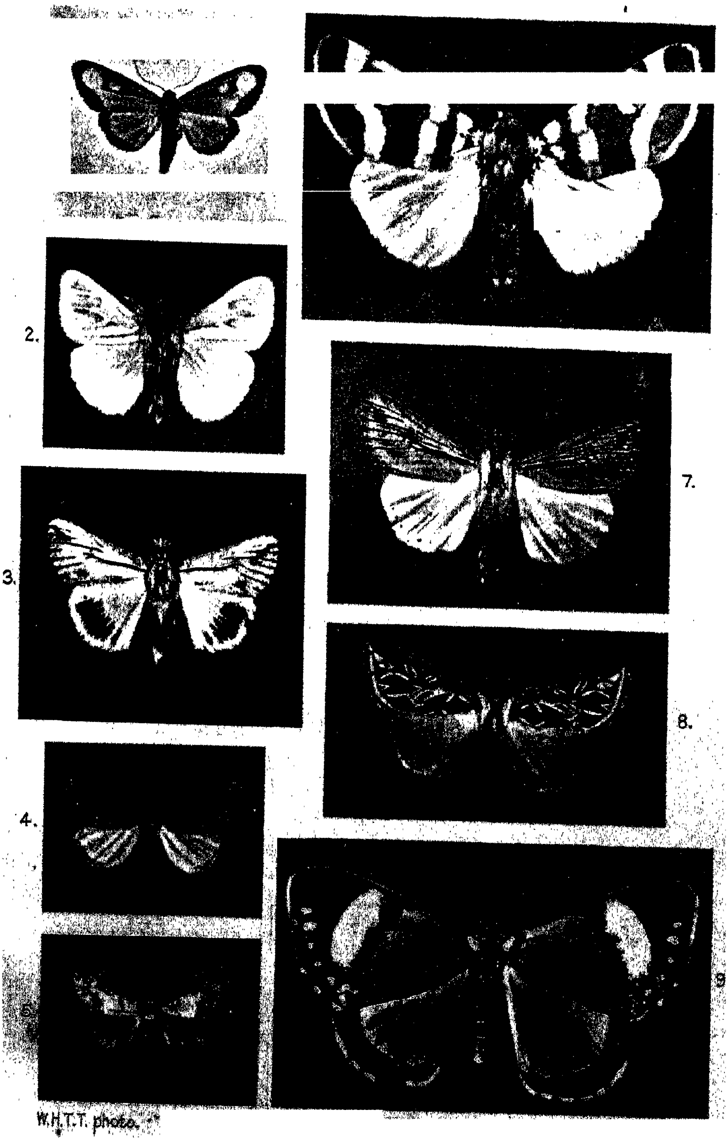

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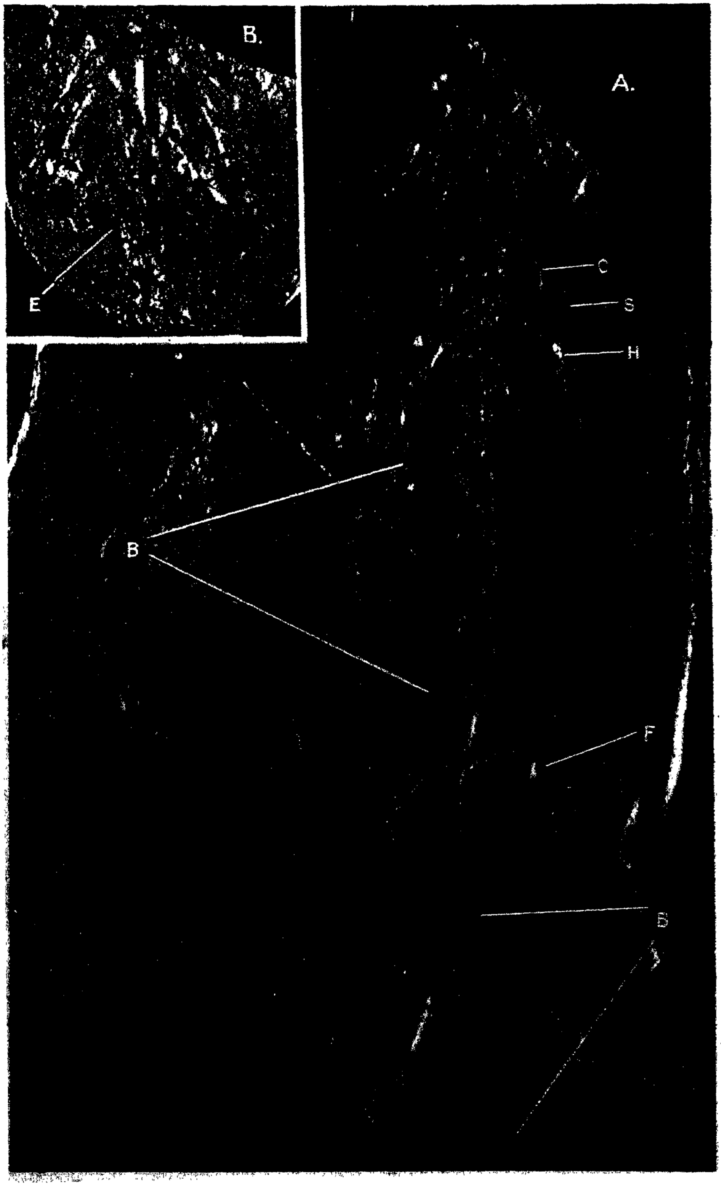

BRANCHIOSAURUS FLAGRIFER sp. nov.

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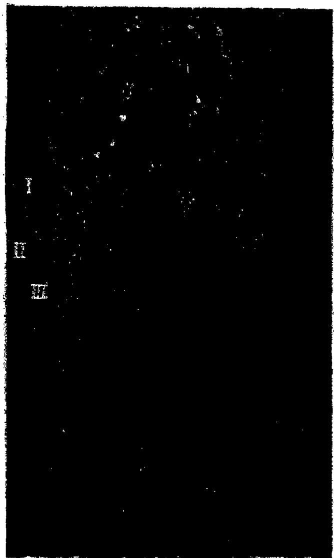
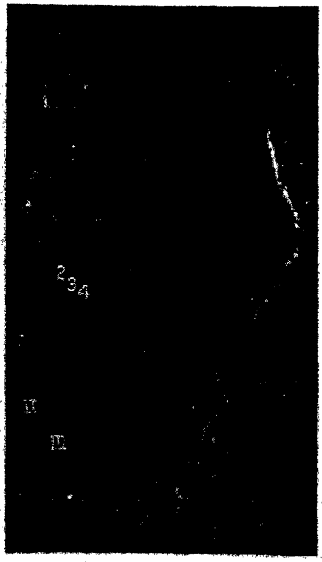
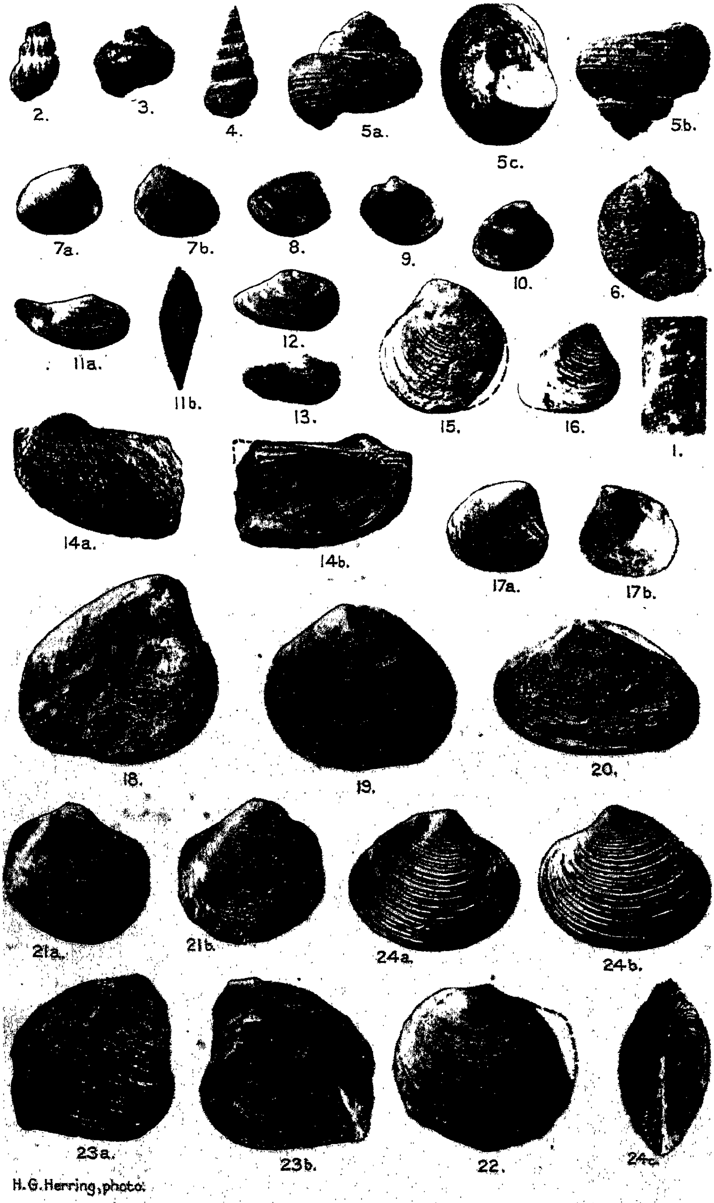


B.

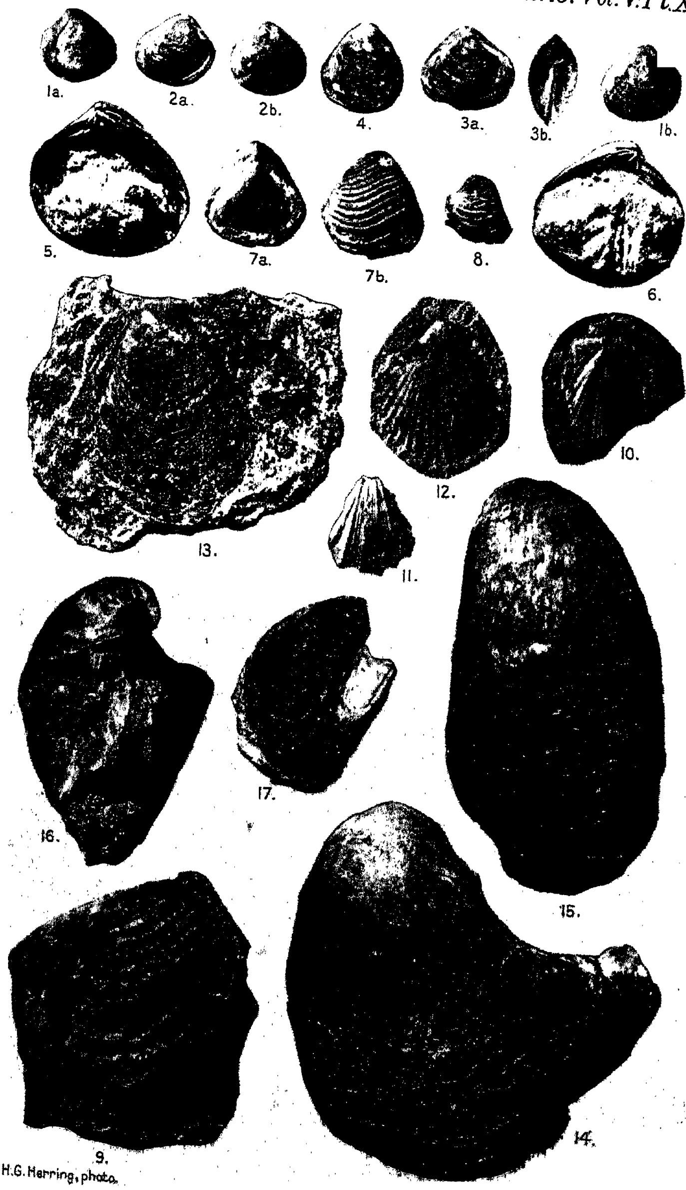


A.

BRANCHIOSAURUS AMBLYSTOMUS, CREDNER.

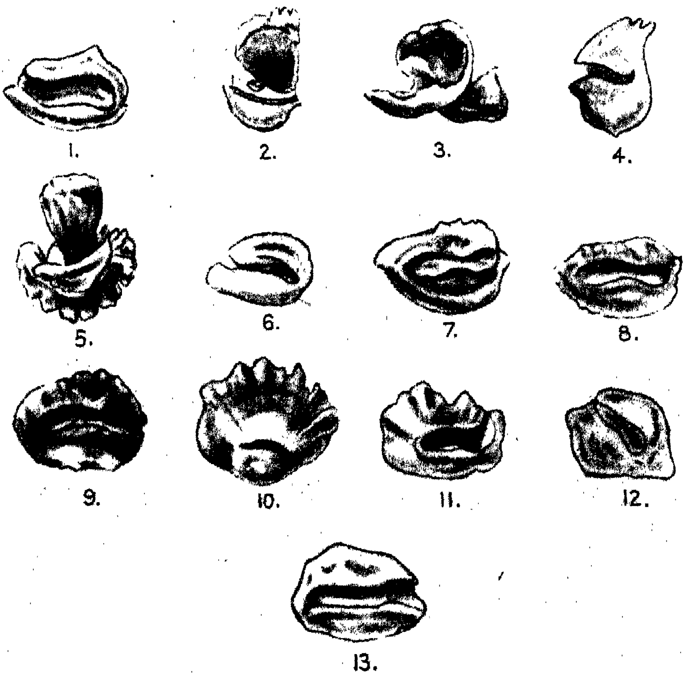


PALESTINE SENONIAN GASTROPODA AND PELECYPODA.



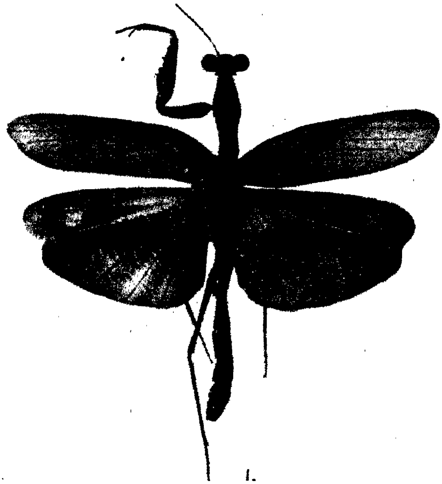
H.G. Herring, photo.

PALESTINE SENONIAN GASTROPODA AND PELECYPODA.



G. Allan Frost del.

OTOLITHS OF THE ORDERS DISCOCEPHALI, PLECTOGNATHI, XENOPTERYGII, HAPLODOCI, PEDICULATI, & OPISTHOMI.



1.

2.

PALÆARCTIC MANTIDÆ.

1. *Microthespis dmitrievi*, Werner.
2. *Iris nana*, sp.n.